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ENGINEERING NEWS.

THE COST OF REMOVING THE GRADE CROSSINGS throughout the State of Connecticut has been estimated by the Connecticut Board of Railroad Commissioners at the request of the Senate. An estimate, made four years ago, that $5,000 per crossing would be the average cost has been proved since to be far too small. There are about 1,200 grade crossings in the State, and the cost of their removal is now estimated to be $20,638,000, divided as follows between various companies: New York, New Haven & Hartford, $10,210,000; New York & New England, $3,380,000; Housatonic, $2,496,000; New London Northern, $660,000. The actual cost of eliminating twelve highway crossings between Mamaroneck and Port Chester on the line of the New York, New Haven & Hartford was $288,152, the minimum cost per crossing being $9,000, the maximum cost $62,999, and the average cost $24,013.

THE NEW YORK BOARD OF RAILROAD COMMISSIONERS reported 10 bills to the Legislature, whose session has just closed, in relation to railways. During the last few weeks of the session the less important ones were reported from the committee, but none progressed far enough to become laws. Like very many other measures intended for the public welfare, there was nothing of a political nature in the bills and the Legislature had no time to attend to them. The few railway bills which did pass were not originated by the Railway Commission. One permits the collection of a ten-cent excess charge on cash fares. Another exempts from the operation of the car-heating law foreign roads passing for not more than 30 miles through the State. Another provides that the petitions for constructing a single track railroad not exceeding 100 miles in length must state that capital stock amounting to at least $5,000 for each proposed mile has been subscribed for, and that 20 per cent. has been paid in, and also that such railroads may begin to acquire right of way when such financial backing is secured.

THE CAIRO BRIDGE is now rapidly approaching completion. It will probably be open by Nov. 1 at latest. The total cost will be about $2,500,000, not $900,000 as was erroneously stated in our issue of May 18, that statement referring only to the cost of one part of the work. The Union Bridge Co. are the contractors, and Messrs. Anderson & Barr took the contract for the foundation work, which has been very successfully carried through in the face of some difficulties.

THE NICARAGUA CANAL CONSTRUCTION CO. sends out the first of its construction expeditions on the day of the issue of this number, per steamship *Alvena*, which is the first of a number of vessels carrying men and material to Nicaragua to commence the actual work of construction on the interoceanic canal.

A party of officers and friends of the company will accompany the steamship down the bay in a steam boat to celebrate the occasion. For this purpose the steamboat *H. E. Bishop* will leave the foot of 22d Street, North river, at 11.30 A. M. on Saturday, May 25, calling at Pier 1, North river, at 12 M., and will accompany the *Alvena* through the Narrows to the Lower Bay.

We are not at liberty as yet to enter into details of the status of the project, but we can assure our readers that early and vigorous prosecution of the work is practically certain.

THE SURVEY OF THE ARID REGIONS of the United States is to be entered upon shortly. Col. E. S. NETTLETON, of Denver, formerly State Engineer of Colorado, has been appointed supervising engineer for the district covering Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, and parts of Dakota, Nebraska, Kansas, and Idaho. W. H. HALL, formerly State Engineer of California, has received a similar appointment, and will devote his attention to the arid lands of the Pacific coast. Both gentlemen will be under the direction of Major POWELL, Director of the Geological Survey. The last Congress appropriated the sum of $250,000 for the work referred to for the ensuing year. This is for the preliminary work, the cost of the surveys complete being estimated by Major POWELL at $5,500,000. The purpose of the work is to increase the water supply in the arid regions by establishing a system of reservoirs for the storage of water and the prevention of disastrous floods in the regions drained by the Missouri and Mississippi rivers; also the withdrawal of the lands benefited from public sale and their segregation for homestead entries in such a manner as will render their occupancy conditional upon an order from the President of the United States.

THE DENVER, COLORADO CANON & PACIFIC R. R. Co., a lately organized Colorado corporation, whose startling yet promising new project has been already described in ENGINEERING NEWS of April 6, has appointed Mr. ROBT. B. STANTON chief engineer, as elsewhere noted, and proposes to build a main line down the Colorado river, through its famous and now inaccessible cañon, to the Pacific Coast, with various branches in Colorado and Utah. A preliminary survey party started from Green River station, in Utah, May 22, and proposes to make the entire trip through Green and Colorado rivers by water, five surf-boats having been shipped from the East. The voyage through several of the cañons is considered dangerous, Major POWELL'S famous expedition over 20 years ago being really the only successful attempt at such navigation, but it is hoped and expected to avoid all casualties. The party numbers 16, including the president of the company, a geologist, and a photographer. One thing is certain: if the line be built, the trip through the cañon in a palace car will be a favorite one.

THE NEW CATHEDRAL COMPETITION, in which 62 architects and architectural firms took part, four of whose plans were to be selected for further elaboration before a final choice was made, has resulted in the choice of the following four plans, no distinction between which has as yet been attempted. They are to be all elaborated, and a final selection made in about six months.

"Gerona"—WILLIAM A. POTTER and R. H. ROBERTSON.

"A. M. D. G."—GEORGE M. HUSS and J. H. BUCK.

"Jerusalem the Golden"—WILLIAM HALSEY WOOD, Newark, N. J.

"Three Arabesque Scrolls within a Circle"—HEINS & LAFARGE and W. W. KENT.

All guesses were wide of the mark with regard to the authorship of this last design, which was generally attributed to RICHARD M. HUNT or J. CLEVELAND CADY, both of which gentlemen competed among the five pre-engaged competitors who were paid $500 each for preparing plans. The other 57 competitors were unpaid.

THE FASTEST FIRST TRIP of an ocean steamship across the Atlantic was made by the new twin-screw Hamburg-American steamer *Augusta Victoria*, which arrived at the port of New York on May 19. The official time from Southampton to Sandy Hook was 7 days, 2 hours, and 30 minutes; this reduced to Fastnet time would be equivalent to 6 days, 8 hours, and 30 minutes. The best day's run was 452 knots. The coal consumption averaged 220 tons per day with an average of 77 revolutions. The *Augusta Victoria* was launched in December, 1888, at Stettin, built by the Vulcan Shipbuilding Co. The dimensions are 460 ft. long, 56 ft. beam, 38 ft. depth. The tonnage is a little less than 10,000 tons. The engines are triple-expansion.

A U. S. SENATE COMMITTEE ON IRRIGATION will commence work on Aug. 1, at St. Paul, Minn., and visit Northern Dakota, Montana, Idaho, Utah, Nevada, California, Oregon, Western Texas, Colorado, New Mexico, Kansas, etc. As it is announced that "they expect to spend three weeks in the field," it will probably severely tax "the resources of modern transportation" to simply carry them over the route laid down, leaving out of the question the gathering of any useful information by the way. But as the expedition is to be accompanied by Mr. R. J. WINTON, the Director of the Geological Survey, who prepared the Senate report of 1887 on this subject, and who is now the Irrigation Engineer of the Survey, the forthcoming committee reports will doubtless be prepared at leisure and from broader data.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a collision May 17 on the Grand Trunk Railway near Dorval, Que. A freight train from Montreal standing at the station was run into by a following freight train; some of the cars were thrown on the next track and were run into by a third freight train from Brockville. Two engines and 24 cars were wrecked, but no lives were lost. It is said that the crew of the second train from Montreal claimed that the semaphore arm was not up, while the operator at Dorval claimed that it was "three-quarters up."——Another rear collision occurred May 20 on the Philadelphia, Wilmington & Baltimore Railway near Charlestown, Md. A freight train had stopped on the block between Charlestown and North East, owing to hot boxes; and it was run into by another freight train, which had been allowed to follow it before the track was reported clear by the operator at the next station. Several cars were wrecked.——The periodical gravel train collision occurred May 16 near Ormsby Station, Pa., on the Pittsburg, Virginia & Charleston Railway; a regular train ran into the gravel train, which was standing on the main track, and several men were seriously injured.

BRIDGE AND TRESTLE ACCIDNETS are reported as follows: On May 14, the engine and one box car of a mixed train went through a burned bridge (or trestle) at Cañon Diablo, on the Santa Fé Southern Railway, 25 miles from Santa Fe, N. M.——On May 18, the Stone river bridge, 9 miles from Nashville, Tenn., on the Lebanon branch of the Nashville, Chattanooga & St. Louis Railway, was set on fire by sparks from a train; an engine was run on to supply water to put out the fire, but broke through the timbers and went into the river. Three men were killed and several injured.——On May 19 the west pier of the water company's bridge at Kaw point, Kansas City, Mo., was carried away by the flood and driftwood, the foundations having been undermined; two of the 120 ft. spans were wrecked and the 36-in. water-pipe broken.——Several bridges in Kansas and Missouri have been carried away by recent floods, including the railway bridge at Liberty, Mo., and 3 trestles on the Missouri Pacific.

FLOODS have caused considerable damage in the southwest. Washouts have occurred on the Missouri Pacific, Union Pacific and Rock Island roads. At Kansas City 2 large mains of the National Water-Works Co. were carried away, and at Argentine, Kan., the false works of the new bridge were badly damaged. The break in the Erie canal at culvert No. 1, on the Montezuma level, has been repaired. The cable railways at Kansas City were seriously interfered with by the flooding of the conduits and engine rooms. The rain storm was very heavy in the vicinity and caused much damage.

PARALLELING EXISTING RAILWAY LINES is to be a difficult matter in the future in the State of Connecticut. By a vote of 136 to 102, the House voted to reject the minority report of the railway committee favoring the grant to the Housatonic Company of a charter to build a parallel road to the New York, New Haven & Hartford from New Haven to New York City. The House also passed a bill containing the following provisions:

Any railroad company in this State may build branches from its main line or from any of its leased lines, provided the construction of such branch is found by a judge of the superior court, upon due application, after such reasonable public notice as such judge may order, to be of public necessity or convenience.

For the purpose of paying the cost of building any such branch, said railroad company may issue bonds secured by mortgage to the amount of one half of said cost, to be verified in the manner now provided by law for verifying the cost of a railroad for the purpose of issuing bonds.

THE NEW YORK, NEW HAVEN & HARTFORD'S petition for authority to increase its capital stock from $15,500,000 to $50,000,000 will next be taken up by the Legislature, and will probably be granted.

A BOAT PROPELLED BY WATER is being built by JAMES LENOX, at or near the foot of 28th St., South Brooklyn, N. Y. Worthington pumps are to be used. The inventor is Dr. WALTER M. JACKSON, and the boat is owned by the Jackson Navigation Co.; C. H. BOTSFORD, Manager, Cortlandt St. and Broadway, New York City.

THE CLEVELAND, CINCINNATI, ST. LOUIS & CHICAGO RAILWAY is to be the name of the consolidated "Big Four" and "Bee Line" systems. At the meetings of the stockholders of the two companies on May 15, the action of the directors in forming the union was unanimously ratified. The actual consolidation will not be made before July. The suit brought by Judge STEVENSON BURKE to prevent the consolidation may cause some delay, but is not expected by the company's managers to be successful.

AN IMPORTANT DECISION just rendered by Judge WATERMAN in the case of the city of Chicago vs. the Chicago, Burlington & Quincy R. R. Co., holds that in the building of the Polk St. viaduct the land damages involved must be paid by the railway company. The city by ordinance granted to the company certain valuable rights, in return for which the company agreed to pay the whole expense of erecting and maintaining the viaduct. It is held that the land damages are part of the cost of the viaduct and must therefore be paid by the company.

ELECTRIC LIGHTING has grown in one year about as follows, said President DUNCAN at the meeting of National Electric Light Association:—In the United States in the last year the number of electric plants has increased from 4,000 to nearly 6,000. The number of arc lamps has increased in the same time from 175,000 to 219,924, and incandescent lamps from 1,750,000 to over 2,500,000. The growth of electric railways is quite as startling.

AN ELECTRICAL ENGINEERING COURSE is to be instituted for the next college year at Princeton College. Examinations for admission will be held in Princeton on June 20 and 21 next. It is to be a two-year course under able instructors and with full apparatus. It will include electrical theory and the application of electricity to industries.

THE MT. PILATUS RAILWAY will be open to summer travel on June 15 next, according to an official announcement sent out by its managers. A new hotel has been built at Pilatus-Kulm, 6,724 ft. above the sea, and the starting point at Alpnach is now in direct communication with Zurich, Lucerne, Interlaken, and all points on the Lake of the Four Cantons.

A POSTAL TUBE across the English Channel is the latest suggestion, and its projector says he thinks it will be difficult for the opponents of a tunnel to find like objections against it. He proposes to suspend two tubes of 3 ft. diameter by means of steel cables which are to be 120 ft. above the sea-level. These cables are to be strung over piers located about 2,400 ft. apart, and in each tube a little railway car is to be propelled by pneumatic power. No parcel weighing more than 450 lbs. will be carried. The estimated cost is modestly fixed at $5,000,000. But how will piers, an English Channel fog, and miscellaneous shipping mix?

WALL STREET has had a sensation recently in the sharp fight between ELIJAH SMITH and HENRY VILLARD and their respective followers regarding the control of the Oregon & Transcontinental Co. The annual election of stockholders occurs June 17, and each side has been gathering into its control all the stock it could find. The result was such a corner as has not been seen on the Stock Exchange for years, and the quotations went up with a rush from 37 to 64½. Of course the advance was only temporary, and was not based at all on the value of the stock.

The real parties who are making the fight are the Union Pacific and Northern Pacific companies, who are contending for supremacy in the three States of the far Northwest. It is likely to be eventually settled by a treaty of peace, similar to that which was nearly consummated a year ago, under which the territory will be divided among the several companies; but the fight at present shows no signs of abating; and if it continues through the summer, there is likely to be a rapid race in competitive railway building in Oregon, Washington, and Idaho, surpassing even the lively work of last season.

LA COMPAGNIE INTERNATIONALE DES WAGON LITS is the official title of the company controlling the sleeping, parlor, and dining car service in Europe. The company was started in Belgium in 1876 and owns all the rolling stock employed, patents, etc. The capital was originally $800,000 in $100 shares. Of the shares 5,993 were given to the Mann Railway Sleeping Carriage Co., of England, for its patents and 53 carriages. The nominal capital was subsequently raised to $1,500,000, of which $676,600 has been paid in. At the end of 1888 the company had in service 223 carriages and 23 *fourgons*. The principal routes are the express services on the South, Mediterranean, and East systems; but on June 1 another will be opened on the Northern Railway of France. The dividend on the $100 shares has steadily increased until in 1888 it was $5.50 per share. As to the rather numerous complaints made of delay and annoyance to travelers, the managers say they do their best, "angels can do no more." The chief trouble lies in the fact that usually the routes traverse entirely different countries over State railways, and the company itself is powerless, so far as changing objectionable methods is concerned.

A QUAY WALL is to be built at the League Island navy yard, Philadelphia, Pa., and the Board of Civil Engineers convened by order of the Navy Department to prepare plans and specifications for the work has forwarded its report to Commodore WHITE, Chief of the Bureau of Yards and Docks. The members of the Board were Civil Engineer P. C. ASSERSON, U. S. N., the head of the engineer corps, now in charge of the construction of the new dry dock at the New York yard, Civil Engineer M. T. ENDICOTT, U. S. N., in charge of the construction of the new dry dock at the Norfolk yard, and Civil Engineer R. E. PEARY, U. S. N., in charge of the construction of the new dry dock at the League Island yard. The last Congress appropriated $75,000 for the construction of this wall, and it is expected that bids will be asked for and the work of construction commenced at once. The completed wall will permit vessels drawing 24 ft. to come alongside at all stages of the tide.

THE BERLIN IRON BRIDGE CO., of Connecticut, has won its suit against the Vermont Construction Co., of St. Albans, Vt. The cause of action was the faulty construction of the piers of the bridge over the Missisquoi river, as a consequence of which the bridge was destroyed. The bridge was contracted for by the Berlin Bridge Co. and they sub-let the masonry to the Vermont Construction Co. under a certain contract and specifications. The work was completed, accepted by the town of Sheldon and paid for, and the construction company was satisfied in full. The Berlin Bridge repaid the cost of the bridge to the town and after a protracted suit has now recovered $5,618.77 from the Construction Co.

PLATE GIRDERS 62 ft. long and weighing 40,000 lbs. each are being put into the new addition to the American Museum of Natural History, in New York. They were designed by Mr. J. C. CADY, the architect, and are of the box form. They will number 28 in all and will support the upper partition walls.

The "Linotype" Mechanical Type-Setter.

The New York *Tribune*, to which we are indebted for the drawing from which the accompanying cut has been prepared, in its issue of Sunday, May 19, contained an exceedingly interesting practical account of what we cannot but regard as a most important invention, which has been developed largely through the efforts of the *Tribune*. The whole history of the invention and the precise state of perfection for practical work to which it has been brought, is given with great fullness and clearness by the *Tribune* in an article from which we condense the following:

The machine now does substantially all the composition of the *Tribune*, only four hand compositors being employed, with about 33 machine operators, for work which would take over 100 hand compositors. The old-fashioned frames and trays, with their square compartments filled with dingy types, have given place in its composing-room to upright structures of brass and iron, like that illustrated, overhung by a network of belts, long lines of shafting, huge metal pipes, and revolving wheels.

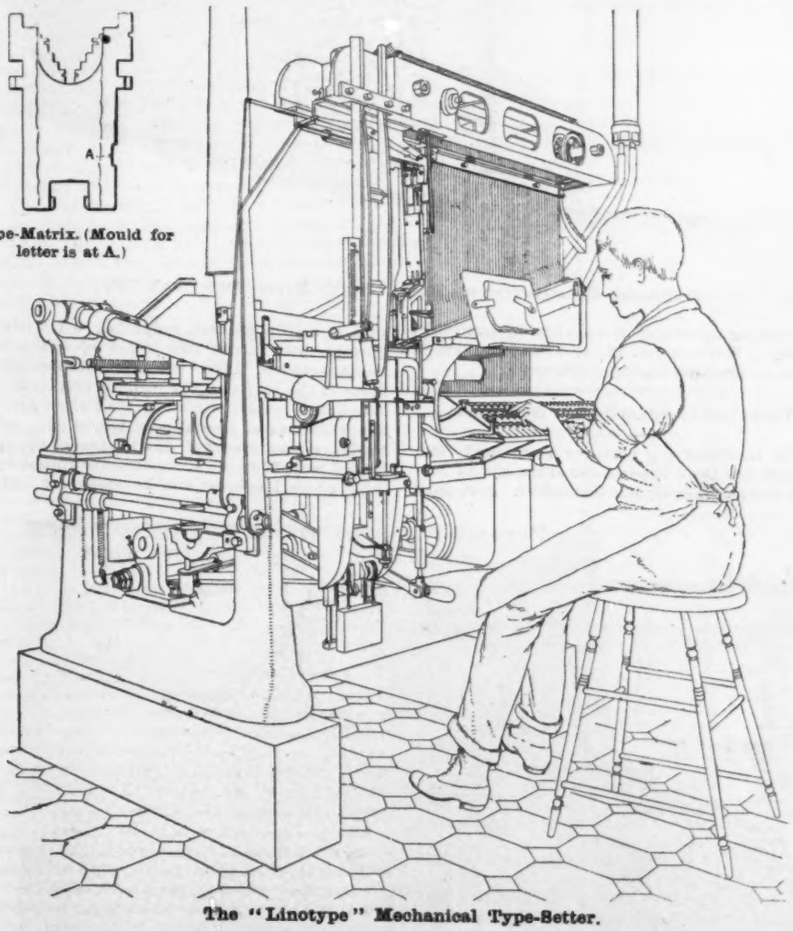
The *Tribune's* experiments with devices for saving time and labor at the case date back for many years. As long ago as 1866, Mr. GREELEY made trials of the Alden machine. This, like the inventions of Mitchell, Delcambre, Frazer, and others, was designed merely to duplicate by machinery the motions of the compositor's hand, and, like them, broke down in practical work. The best of this class of machines were, perhaps, those of the late G. A. BURR, which, up to a few months ago, had been in use by the *Tribune* for several years. The first was put in in May, 1880, during the lifetime of the inventor and under his supervision, and the number was subsequently increased to three. The results were fairly satisfactory, but there were fatal obstacles to success. The original cost was great and the expense of repairs considerable. A specially prepared type was required, which broke easily and wore out very fast. One operator was needed to set the matter, another to justify it, and a third to attend to the distributor (which was a separate piece of machinery). Frequent stoppages were necessary for replenishing the font, and the output of each machine, under the most favorable conditions, was only from 4,000 to 5,000 ems per hour, so that the actual saving was small. A good hand compositor will set about 12,000 ems per day of eight hours, or including time lost in distributing the type, say 9,000 ems. Moreover, there were numerous sources of delay, the type "pied" easily, and typographical blunders were unpleasantly common.

In the fall of 1884, however, a new and wonderful instrument began to be talked about which would found and compose its own type, viz., the Linotype, invented at Baltimore, Maryland, by OTTMAR MERGENTHALER, a native of Wurtemberg, Germany, who was born in 1854, learned the trade of a watchmaker, and came to this country in 1872. Its conception was due primarily to Mr. JAMES O. CLEPHANE, a Washington stenographer, who has made writing and printing machines a hobby, and who, in 1876, employed the engineering firm of which Mr. MERGENTHALER was a member to work from drawings by a Western inventor. Mr. MERGENTHALER immediately discovered a singular aptitude for this kind of work, began experimenting, and soon improved upon the crude device originally submitted to him. His first idea took the form of a rotary machine, with keys for impressing female dies in a continuous strip of heavy paper, which was then cut into short lengths for adjustment as the matrix of an entire column or page. This was superseded by a machine controlling a series of sliding bars, each bearing on one edge all the characters and spaces. A key mechanism moved these bars endwise, so as to bring a selected character on any bar into line with a selected character on any other, and thus form the matrix of a complete line for casting. It was not until 1880 that a complete change of system was made, and not until 1884 that the machine was finally completed.

In appearance the Linotype has been not inaptly likened to an upright piano. It is about 5 ft. long, 5 ft. high, and 3 ft. broad. The most conspicuous objects supported by the heavy iron base are a typewriter keyboard and a series of vertical flattened tubes. Each of these tubes or magazines contains a

number of matrices of brass like that shown in the small cut, having the mould for some one letter or character stamped in the further edge. The bottom strip or matrix in each tube rests in a slot at the end of the corresponding key; and when this key is depressed, the matrix at once drops in an upright position into a groove or channel, sloping above the keyboard from right to left. A powerful air-blast instantly forces the matrix down this sloping channels, along a wire which maintains it in its upright position, to the lower end of the groove, and here two metallic fingers, working automatically, push it out into full view upon a horizontal slide; and as it is marked on the outer edge with the letter it represents, the operator can read and correct his work (which is not reversed) as he goes along. When all the matrices of a word are assembled on the slide, a touch on a particular key brings down a long, thin, wedge-shaped strip, or "space-band." The thicker end of this wedge hangs below the matrices, just

Type-Matrix. (Mould for letter is at A.)



The "Linotype" Mechanical Type-Setter.

over a metal plate, so that when the line is finished the automatic raising of this plate will push the space-bands upward through the line until the different words are all equally divided, and thus the nice process of "justification," which has been an insuperable obstacle to many machines, is accomplished at a single stroke.

The line is now ready to be cast, but the operator simply moves a lever, and goes on with his work at the keys, leaving the machine to do the rest. And it does it quickly and well. As the lever moves, the space-bands spread the words, a pair of clamps seize the line of matrices, remove them from the slide and press them against the face of a vertical disk. Extending horizontally through this disk is a narrow opening, or slot, of the exact length of the required type-bar. Behind it, a small gas furnace keeps a pot-full of type metal constantly at liquid heat; and while the moulded edges of the matrices are held against the disk, an automatic force-pump (a simple plunger entering a closed chamber filled with molten type-metal) throws out a jet of molten metal through the slot. In an instant a block is formed, of the size and shape of an ordinary line of types, bearing on its face in relief the letters corresponding to the line of matrices. The disk then makes half a turn, the bar meets a pair of automatic knives which trim it square, and the next moment it is pushed out, solid, but still warm, at the bottom of a galley standing on end against the machine at the operator's left.

Now a series of even more ingenious operations are performed, still automatically, while the operator is writing the next line. Each of the matrices which have just been used must be restored to the tube from which it originally came, and in effecting this the machine displays an almost more than human intelligence. An operator intrusted to perform such a task by hand would first pick out the different sorts, then carefully compare them with the tubes, and finally use dexterity in placing them where they belonged. Not so the machine. As soon as a line is cast, it simply withdraws the matrices from their position against the disk and lifts them by automatic carriers to the top of the machine. Here they encounter a sort of endless belt, fitted with hanging loops, which catches them up and travels with them from left to right above the tops of the tubes.

The tops of the matrices are cut in the shape of a V as shown, the inner edges of this V being notched, Yale-lock fashion, in such a manner that all the matrices of the same character are alike, and different from those of any other. As the belt moves along, these Vs closely hug a stationary bar placed between the loops, and fitted with an arrangement of fine ridges, which differs over every tube. These ridges correspond with the notches in the different Vs, in such a way that when a matrix is brought exactly above the tube to which it belongs, it no longer engages any ridges on the bar, the loop ceases to sustain it, and it falls at once into place, ready to be used again. To guard against possible mishaps, the distributing bar is connected with wires from a battery, by means of which the premature dropping of a matrix closes an electric circuit and stops the carrier belt. All special type or broken or worn type which do not drop into any tube in this way fall into a concave "pi box" visible at the right of the cut, whence they are taken by a boy and cast out or distributed by hand.

The capacity of the machine in the hands of a competent operator is from 3,000 to 5,000 ems per hour, and six weeks are generally sufficient for a person of average intelligence to learn to attain this speed. Its other merits are obvious. It cannot "pi," does not destroy or scatter type, involves no waste, and furnishes a constant supply of new characters. The proofs are cleaner and corrections more quickly made (usually by resetting the entire defective line), and the product is more easily handled for the make-up. The hands make fewer motions, the arm is never cramped from holding a composing-stick in one position for hours at a time, and the tedious and unprofitable labor of distribution is entirely done away with. The spacing is always mathematically exact.

The first machine was put up in July, 1886. In the January following 5 had been received, but only 2 remained in use. The first was so inferior that it had to be taken down and rebuilt, while 2 others were little better. Actual operation discovered a multitude of defects which had never before been dreamed of, and although no radical changes were made, it was found necessary to modify several details of the construction. Indeed, but for the *Tribune's* faith in the ultimate success of the machine, the experience of the first twelve months would have insured its abandonment. For a long time no suitable metal could be procured for casting, nor its temperature satisfactorily controlled. The matrix moulds were untrue; the matrices themselves were warped and constantly blew out of the channel; the metal squirted between them and spoiled the cast; the air-blast was unmanageable; the tubes became clogged, and the operators were poisoned by fumes from the casting-pots; and when the linotypes were finally produced, they refused to stand upright in the form.

By the beginning of 1888, 14 machines had been received, yet serious obstacles were still to be overcome. There was no ready mode of changing the measure. The headings had to be set by hand and the use of italics abandoned altogether, and the simultaneous use of two styles of type made good results impossible. The movable types, elongated by the heat of repeated stereotyping, still took the impression off the shorter type-bars, which, being new every day, retained their proper size. Perhaps the most troublesome experience of all was with the matrices. The moulds for these were at first electrotyped from ordinary type, but after repeated casting the electrotyped deposit pulled off and left them useless. A machine was then devised to cast them, but no sooner was this completed than it was found that there was no metal at once soft enough to take a good mould and hard enough to be cast from again without melting. Punching with steel dies directly into the face of the brass was the next method tried; but this spread the mould so as to interfere with the justification and prevent impressions of uniform depth; and it was only by the use of a specially hardened brass that satisfactory matrices were at last obtained. As to the metal, an alloy of bismuth, antimony, and lead was, after much experimenting, shown to give the best results, and the pots were fitted with covers and chimneys to carry away the fumes.

The present outfit of the *Tribune* is 43 machines, operated by about 32 old compositors. Editorials, news dispatches, city articles, market reports, literary matter, the small type advertisements, are all composed by the linotype machines; and only the stock and bond tables, the little court calendar, the heavy display type in the advertisements, and the large pica head lines give employment to the 4 men still at the case. A clever operator turns out tabulated matter where no rules are involved about three times as quickly as by manual composition. One machinist keeps the machines in order.

The first cost of so elaborate a plant was, of course, considerable, as were the expenses incident to its installation, and these must be taken into account in any calculation of the economy of the change. A small vertical engine of nominally 12 H. P. was found inadequate to the demands of the office after 22 machines had been put up, the horse-power required for working the distributor, force

pump, and other automatic parts being about 0.17 for each machine. A large No. 5 horizontal Root blower supplies the air-blast for forcing the matrices into the channels, making 160 revolutions per minute, discharging 23 cu. ft. of air at every revolution, or 3,680 cu. ft per minute, or a pressure of 1 lb. per sq. in. above the atmosphere. Stop-cocks connect each machine with the draft and regulate the blast for the furnace. The chimneys of the casting-pots are connected with a large main flue leading to the roof, and incandescent electric lights are brought before each machine. Besides the cost of these fixtures must be reckoned the current outlay for gas consumed, amounting in the case of the *Tribune* to 270 M. ft. per month: the expense of new type-metal; new matrices; cost of training operators; royalties on machines ($100 per quarter, or $400 per year) and interest. It is stated, however, that the sum paid for the lease of the machines and for fitting them in position for actual work in an office where steam is already used, is much below the first cost of the type, cases, and other paraphernalia required to equip an ordinary composing room to do an equal amount of work; while the running expenses enumerated are nearly, if not quite, set off by the saving in wear and breakage of the type in ordinary work at the case.

The gradual, yet rapid progress of perfecting the machine, and the work of the operators, is indicated very practically and definitely by the following figures, abstracted from the *Tribune's* much longer account, in which each operator's work is given by name for three separate weeks:

Week ending	*No. of op'rs.*	*M. ems per man.*	*Cts per M. ems.*
1888			
Feb	18	101.	21
March 28	29	86.2	26
May 7	31	89.6	23⅝
Oct. 14	38	104.0	20.2
Nov. 14	34	102.	19.5
Dec. 12	35	108.4	18.7
1889			
Jan. 10	32	110.0	19.8 (max.)
March	31	116.4	to 17.8 (min.)
April 3	30	114.7	18.5
" 10	32	138.1	15.4

The last week was a special test to this extent, that especial pains were taken to keep all the operators fully supplied with copy, and probably with "clean" copy, to a greater extent than is ordinarily practicable. The machinery, however, was not specially overhauled for the test, and there were some break-downs and stoppages for which no allowance was made. About 120 to 140 thousand ems seems the ordinary weekly maximum, although 150 to 160 are occasionally set. To show how pay and work varies with different grades of employés, we have prepared the following classified table from the *Tribune's* full table for this test week:

Week ending April 10, 1889.

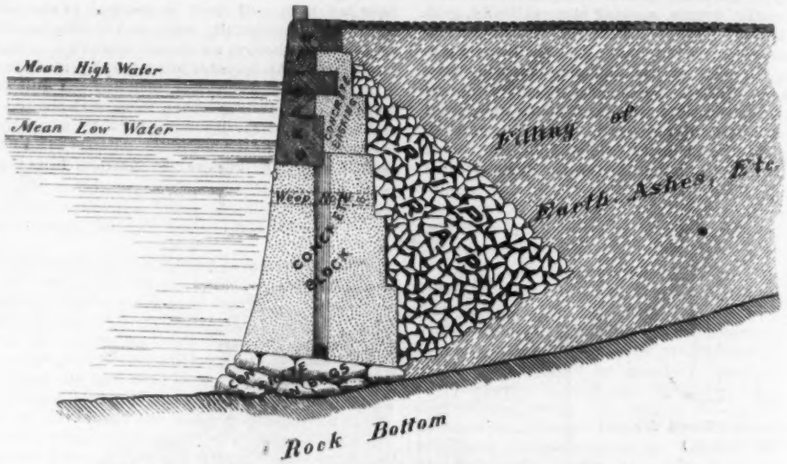
No. men.	*Average pay.*	*Weekly M. ems.*	*Cts. per M. ems.*
4	$25.50	173.4	14.5
10	25.79	153.9	16.6
11	20.13	130.6	15.3
5	14.96	112.1	13.6
2	13.50	98.3	13.7
32	$21.35	138.1	15.4

One man who appears in all the tables to be specially expert set the large amount of 192 thousand ems. The general rule of the office seems to be, as yet, to pay by the week, and not by the thousand ems, but to regulate the weekly pay so that it may amount to about an equal price for equal quantities. All the first 14 men above, who all did between 120 and 140 thousand ems, received the highest rates; the next 11 men varied from $12 to $20; and so on down. The final mode of paying is likely to be by measure, as with hand compositors.

All the above quantities are of *corrected* work, typographical corrections being of course less easy, in theory, at least, than when every letter consists of a loose piece of metal. Lines are cut and in part replaced or cast entirely anew, when necessary, but the main proofreading work, as we understand it, is done on the copy before it is set up, so as to make sure that it is entirely correct.

The rate given in the last table above, 138 thousand ems per week per man, is just about double the average work per man of good compositors; but as the work of distribution is also saved, the actual increase in each man's capacity is about 2½ times, the cost being claimed to have been less than one-third of the usual sum. Should the machines continue to prove as successful as they now promise to be, the work is likely to fall, as typewriting has, largely to women and girls, men being all but entirely displaced, for the work should be less exacting both physically and mentally.

The machines are manufactured by the Mergenthaler Printing Co., which has a factory in Ryerson St., Brooklyn, and an office in the Tribune Building, New York. About 130 machines have been turned out to date, and the factory is behind its orders. Connected with the factory is a job office for training operators. Newspapers in Louisville, Chicago, Washington, Philadelphia, and Providence are already using the machines.



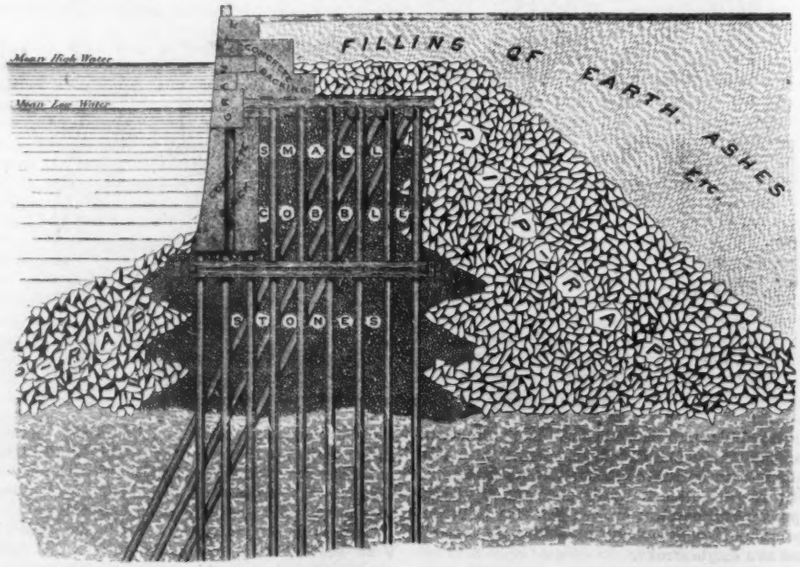
Bulkhead Construction on Rock, North River, New York City.

Bulkhead Construction in New York.

The accompanying cuts are reproduced from plans of the Dock Department of the city of New York and generally explain themselves. Both show combined concrete and granite face-walls, with the difference that the one is founded on piles and the other on rock bottom.

The piles used are from 16 to 28 ins. in diameter and any length up to 90 ft. The vertical piles have the three front rows cut off 15.3 ft. below low-water, and the other piles are stopped just above mean low-water and are there capped. After the piles are driven, the rip-rap and cobble filling is put in layers interlacing, as shown in the cut. The binding frames are made of 5 by 10 in. spruce timbers, placed one above the other, and wedged up at the ends by 8 by 8 in. oak blocks.

The concrete blocks forming the base of the wall are each 6 ft. in length measured along the wall and 7 ft. and 5 ft. wide; the vertical height is 13 ft. in front and 14 ft. in the rear, thus leaving a step for the granite wall. The weight of the blocks is about 70 tons, and they are lowered in place by the 100-ton floating derrick, belonging to the department. Grooves down each side and across the bottom of the block, permit the withdrawal of the chain. A bed is prepared for these blocks by first lowering down on to the pile heads a wooden frame with a marlin network supporting a mattress of burlaps, with about two inches of slow-setting mortar between. Divers cut loose the frame and it floats to the surface. The inclined brace-piles are driven by a special pile-driver, with about 3 ft. between centers and on a slope of two to one. After the brace piles are cut off and the tops of the piles capped with 12 by 12-in. timbers, the granite wall, being above low water, can be easily set and is backed by concrete. Only oak treenails are used as fastenings, there being no metal to corrode in the structure. The sea-wall, based on rock, is practically similar in its construction.



Bulkhead Construction on Piles, North River, New York City.

The concrete blocks are made of two parts sand and one of Portland cement as a mortar, with about five parts of broken stone added, the proportions of the latter varying, however, with the stone used. The weep-hole shown in the cut is to permit the escape of any accumulated water in the rear of the wall. The vertical hole formed by the meeting of the groove in adjoining blocks is filled by concrete in bags rammed down. Mr. GEORGE S. GREENE,

Jr., M. Am. Soc. C. E., and chief engineer of the New York Department of Docks, has been in charge of all the work done since 1875 in this department.

The Buffalo Trace Viaduct, Kentucky Midland Railway.

We are indebted to Mr. R. S. POLLARD, Asst. Eng. Kentucky Midland Railway, for the illustrations and data here used in describing the Buffalo Trace Viaduct lately erected on that road. The viaduct is located about one and one-quarter miles from Frankfort, Ky., on the railway now being built from the latter city to Paris in the same State, a distance of 56 miles. Mr. J. M. DOUGLAS is the chief engineer.

The viaduct, completed on April 10, 1889, was designed by Mr. E. THACHER, C. E., lately with the Keystone Bridge Co. and now located in Decatur Ala. It was built and erected by the Shiffler Bridge Co., of Pittsburg, Pa. Mr. J. W. WALKER, proprietor; Mr. T. C. REA was the foreman of erection.

The base of rail is 158 ft. above the lowest point in the ravine crossed. There are seventeen spans in all, the four spans at either end being 30 ft. and the remainder 30 ft. and 60 ft. alternately. The total length of this viaduct is thus 660 ft. and the total weight of metal used is 395,000 lbs. Fig. 1 shows the general arrangement of piers and girders and also the sections of the various members. These data are so complete, aside from detail of connections, that no further description is necessary.

The traveler (Fig. 2 and Fig. 4) was of very efficient design. It was somewhat similar to those used in the erection of the Niagara bridge and the Kinzua viaduct, but had the advantage over the latter in that the boom covered two spans, so that both bents of a tower could be set up without moving the traveler. In this Kinzua viaduct the first bent beyond the traveler was raised by it and the second bent was set up by gin-poles.

Brick for Street-Paving.*

There are perhaps fifty cities in the United States using brick pavements. Some have had them over 15 years. In Decatur, Ill., brick pavements have been in use for 6 years; in Bloomington, they have been used for 15 years; and in Charleston, W. Va., for a longer time. They are in use in Jacksonville, Peoria, Quincy, and Springfield, Ill., also in Kansas and Nebraska; and a number of cities in Ohio are using them with good results.

All brick pavements have not given satisfaction, as the contrary effect has been produced when common building brick has been used. They begin to show the wear in a very short time if soft brick is used, but good hard brick gives satisfaction. There is no paving material equal to hard brick, excepting granite blocks, and it is doubtful if they would last as long were they as small as bricks. There are few cities in the United States where brick could not be laid for one-third the cost of granite blocks.

It may be urged that suitable clay for manufacturing paving brick is scarce, but there is nothing in this country so plentiful. Of over twenty different samples of clay sent from various portions of Illinois and other States to the Decatur Tile Co., all excepting one have been made into paving brick, although some kinds are much better for the purpose than others. This company has made about 5,000,000 bricks per year during the past 4 years, 75 per cent. being paving brick. Over 5 miles of the streets of Decatur are paved with brick, and the City Council is planning to have more of them thus paved.

The clay used by the tile company mentioned is a common yellow joint clay, having a large percentage of silicate and iron. It is tempered or soaked for 24 hours before using, then carried by a belt to a stone separator and crushers. Dropping from the crushers to an elevator, it is fed to the brick-machine. From this machine it runs in three streams upon a moving table, and is cut by wires, fastened in a frame into bricks 8¾ ins. in length. The die through which the clay is pressed on leaving the machine is 4 × 2¼ ins. The bricks are then set upon drying-cars to be dried in hot-air tunnels, or set on slats in a building warmed by steam, or placed on a drying-floor heated from the burning kilns or small furnaces. When dry, they are carried in wheelbarrows and set "skintling," or at angles across each other, to allow the heat to pass between them in the down-draught kilns. Experience has proved that good paving brick cannot be burned in open, up-draught kilns, if made from the clay described.

While some kinds of clay will stand fire long enough to burn as hard as rock in open kilns, yet even then

*J. G. SHEA in *Science*.

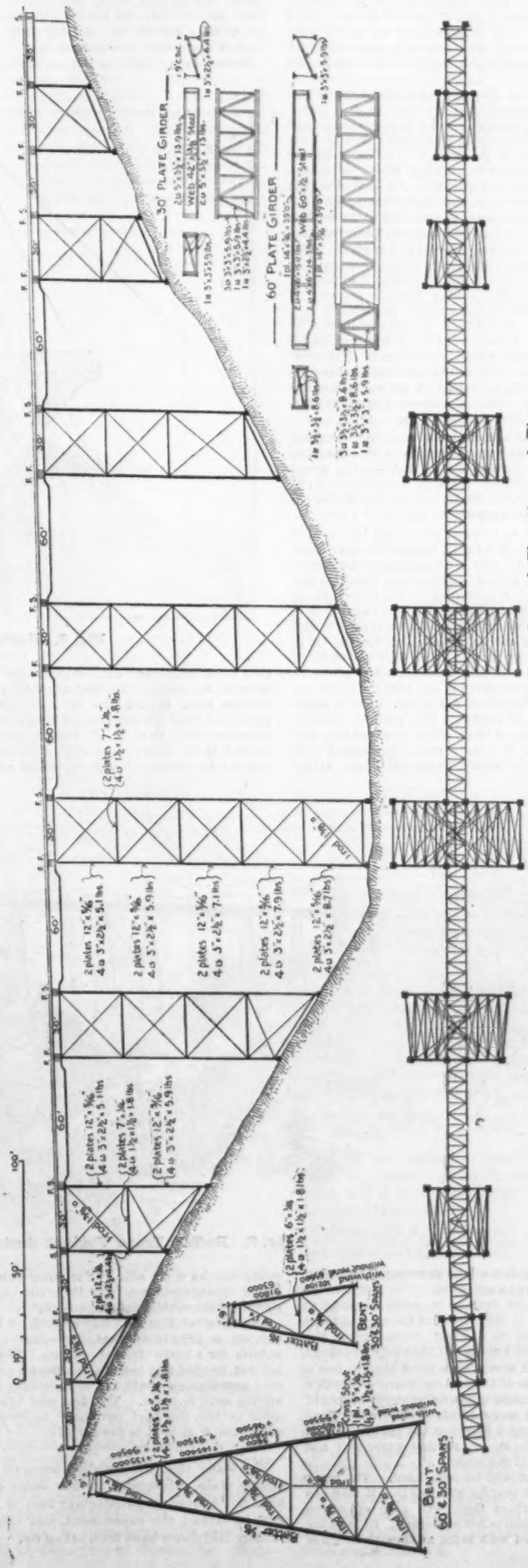


Fig. 1. Buffalo Trace Viaduct: Kentucky Midland Ry. General Elevation and Plan.

the bricks would be much better in shape and quality if burned in closed kilns. The bricks are burned from 6 to 7 days, the first 3 or 4 days very slowly, called "water smoking." It is necessary to watch very closely when finishing the burning, as there is great danger of running the bricks together and spoiling the whole mass.

The great drawback to using all kinds of clay arises from the gravel found in many clay banks. There are machines for separating the larger stones and crushing the smaller stones, which work very well excepting where there is limestone. The only remedy for that species of clay is washing, which is too expensive for common brick-making. A machine that will separate all gravel or other hard substances from the plastic clay, and leave it fine enough to be worked into terra-cotta, has been tested, and fulfills all the requirements. It is very simple, and will separate large quantities of clay with very little power. This machine will help manufacturers to use clays which at present are worthless, but which may become sources of wealth when passed through suitable machinery.

Some may smile at the idea of making bricks by machinery, but it is believed that brick making by hand will soon become a thing of the past. The stiff-clay, machine-made brick will be used for paving purposes, bridges, docks, tunnels, and all works that require great strength; while dry-pressed brick will become the building brick of the future.

Four specimen bricks made by the tile company mentioned, and picked up at random, were submitted to a test by the Chicago Forge & Bolt Co. about 3 years ago. The ultimate crushing resistances of the samples were 252,000, 228,000, 210,000, and 318,000 lbs. respectively. The bricks measured 7¼ × 2¼ × 4 ins.

The construction of a brick pavement is a simple matter. The foundation being brought to the proper grade, there is spread over it 6 ins. of gravel or sand, which is struck off with a board gauge fitted for the grade of the street. A course of brick is then laid on the flat surfaces, running lengthwise of the street. It is not necessary that this course should be as hard as the upper course, being only a foundation for the brick that will receive the wear. Over this an inch of screened sand is spread, gauged, and properly smoothed off. The top course is laid with the bricks on their edges lengthwise across the street. Care is taken to break joints in both courses. The whole is covered with an inch of screened sand, which is swept into the crevices. After this is done, a roller weighing 5 or 6 tons is passed over the pavement several times. If the street is properly rolled, it will be as smooth as wooden pavement, and almost as noiseless.

The street should be drained in some manner, as the lasting qualities of the brick and the even surface of the street depend to a great extent upon the drainage, as it is a well-known fact that water weakens brick very much. It would be a good plan to run a 6-in. drain tile outside of the curbing connected with a 4-in. tile running through the curbing at the corner of each block. This will carry off all surface water; and if the 6-in. tile is about 3 ft. below the surface, it will drain the sides of the street, so that water will not reach the foundation of the street.

The upper course should be very hard. The brick should be vitrified. It may be objected that if they are burnt to a glassy surface they will chip off or be crushed. That objection is not sustained. In Decatur are whole blocks paved with brick as smooth as glass and as hard as flint, and no brick of that description shows any signs of wear. The wear comes on the objects passing over the bricks, which are harder than steel, for a file will not scratch them: in fact, when broken open, they resemble flint.

Horses do not slip or fall on brick pavements as they do on granite blocks, owing to the small surface between the seams. Another advantage possessed by vitrified brick is that they will not soak water. If water and frost are kept out of brick, they are almost indestructible. Prof. R. T. BROWN says, "Clay well burned is as nearly a neutral substance as any in nature: its elements, being well united and in chemical equipoise, have no affinity for other substances that might disengage them from their combination. It is therefore chemically indestructible."

The Decatur Tile Co. laid a block of brick 4 years ago, on a private contract, agreeing to make all repairs for 5 years free of charge. The street has not yet needed any repairs whatever, and from present appearances it will not be necessary to make any for the next 20 years. The first cost of such a pavement is low, the best pavement in Decatur costing only from $1.25 to $1.50 per sq. yd.

WE learn that the Swedish tests of the Stuart elastic plate, illustrated in our issue of April 27 have not proved so satisfactory that it has seemed wise to extend the experiment, and that those previously laid down have been taken up.

The Portelectric Carrier.

A new electric carrier, designed primarily for the very rapid transportation of light merchandise or mail matter, has been invented by Mr. JOHN T. WILLIAMS, a working model of which is on exhibition in the Old South Church, Boston.

The structure consists of a light girder of plate iron, carried on a single line of posts, and so arranged that the carrier, a long narrow box of sheet steel provided with wheels at either end which run on vertically placed rails, passes through the center of the girder. At distances of about 2 ft. apart along the track are placed coils of wire which entirely surround the girder at right angles to the direction of motion, and also the carrier at the moment when the carrier passes. The end of one coil is connected to the next coil and so on successively, so that an electric current from a generating dynamo passes the whole length of the track traversing the coils successively. A make and break tilting lever at each coil cuts off the current from the coil as the carriage passes. The principle of this invention is the very old and well-known fact that a coil of wire through which an electric current is passed has the property of attracting or drawing in to its center a piece of soft iron, which is

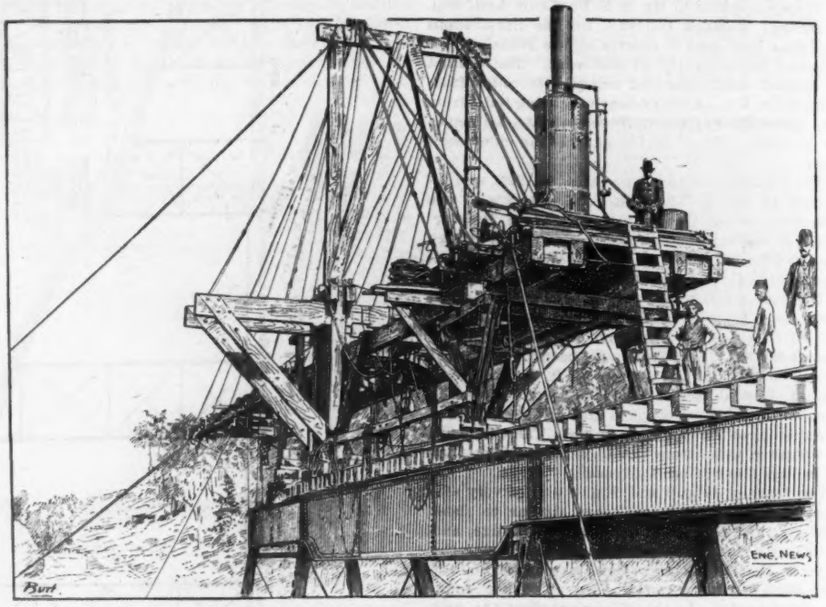


Fig. 2. Buffalo Trace Viaduct; View of Traveller.

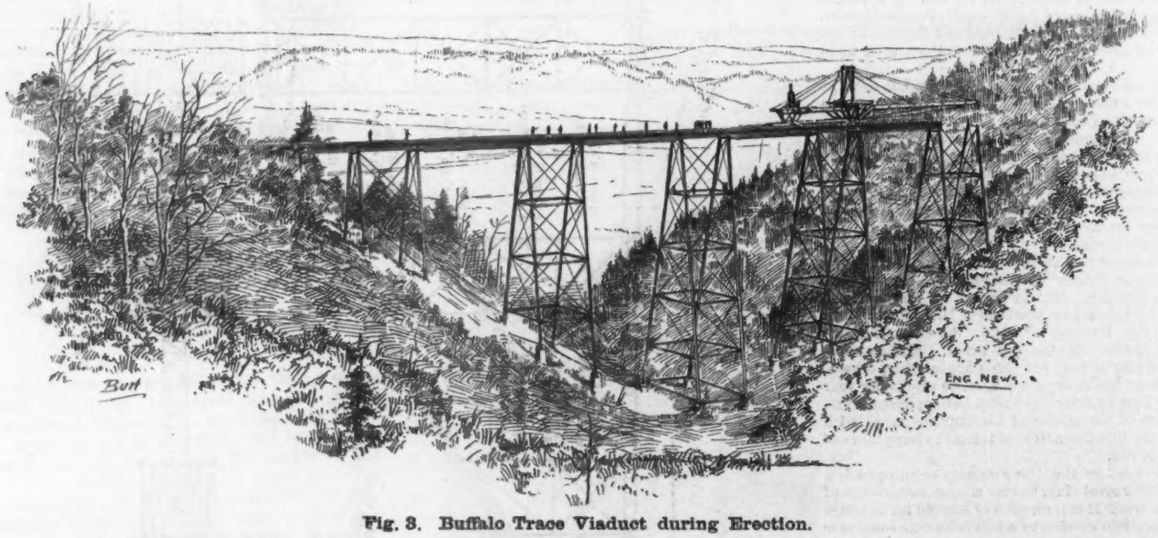


Fig. 3. Buffalo Trace Viaduct during Erection.

thus temporarily magnetized producing the electromagnet. The whole invention is but a new application of a solenoid magnet.

In the model shown, the cutting off of the current from each coil is effected automatically and in a very beautiful manner by the carrier itself. The carrier, if made of iron, would come to rest when half way through the coil. To release the current, which would act as a brake if continued beyond this position of the carrier, the carrier itself is made of steel and permanently magnetized. The effect now is, on starting the carrier with the north pole, say, towards the south pole of the coil, that the carrier is attracted or sucked into the coil. As soon as the north pole of the carrier comes opposite the north pole of the coil, repulsion occurs, and this acts to release the tilting lever which makes the circuit, and this drags back, cutting off the current from the coil and connecting it with the next coil, and so on.

In the model shown, each coil contains about 60 lbs. of No. 14 wire. The carrier is a steel box about 4 by 6 ins. in section and 4 ft. long, or of sufficient length to extend to three coils, and moving capacity for 1,000 letters. The potential of the current used is 110 volts, and the total power 4-7 of a horse-power. With these proportions the carrier shot across the hall with certainly surprising celerity.

It is proposed to construct a line, say from Boston to New York, for the delivery of letters, say every five minutes, thus avoiding the present accumulation of the mails and loss of time in transportation. The mail line would need coils placed so close together as 2 ft. only at the start; at high speeds, 6 or even 10 ft. apart would be sufficient, while the carrier would be 12 ft. long. It is estimated that letters could be sent from Boston to New York by this apparatus in two hours' time. The cost of the track would be from $10,000 to $20,000 per mile, and the carrier, weighing 56 lbs., requires a constant tractive force or pull by the magnetic coils of 50 lbs. only. At the rate of only a mile a minute, the carrier would travel 1,440 miles a day at a cost of 30 cents, reckoning the cost of the power at $100 per horse-power a year.

The writer does not see why the principle involved can not be equally well applied to projectiles, as, for instance, a dynamite gun. With only three small coils in use, a steel bar magnet was driven through a tube with great velocity and at a considerable angle of elevation. At very high speeds the wheels upon which the carrier rests can be connected into sliding ways, or rollers can be inserted in the track to minimize the friction.

The New England Portelectric Co. has been formed, with headquarters at Boston, for the development of the invention. Gen. JOHN M. CORSE, Postmaster at Boston, is President; THOMAS W. BRICKNELL, Secretary and Treasurer; Prof. A. E. DOLBEAR, Electrician. The directors include Lieut. Gov. D. G. LITTLEFIELD, of Rhode Island, HENRY B. PIERCE, Secretary of State, Mass.; Hon. SAMUEL N. ALDRICH, U. S. Sub-Treasurer; HORACE W. GILMAN, of Nashua, N. H.; WHIPPLE V. PHILLIPS, of Providence, and CHAS. P. SEARLE, of Boston.

What the advantages or disadvantages of this method of quick transit may be, as compared with the Jenkins or Chandler system of electric telpherage, time and experiment only can determine. There would seem to be an economic principle here embodied in the fact that when the plant is once built, little loss results from transporting the prime mover or power in detached portions, as is now the case with the locomotive. Probably power conveyed by a well insulated wire would lose a smaller percentage of its energy than by any other method, and any quantity of power can be taken off the main line immediately at its point of application. The interest on the cost of the plant need only enter as an element in the operating cost, while the carrier itself is extremely simple and cheap.

The idea opens up, at any rate, some very interesting subjects for study and we shall be glad to present further details as soon as more exact measurements and conditions are reached.

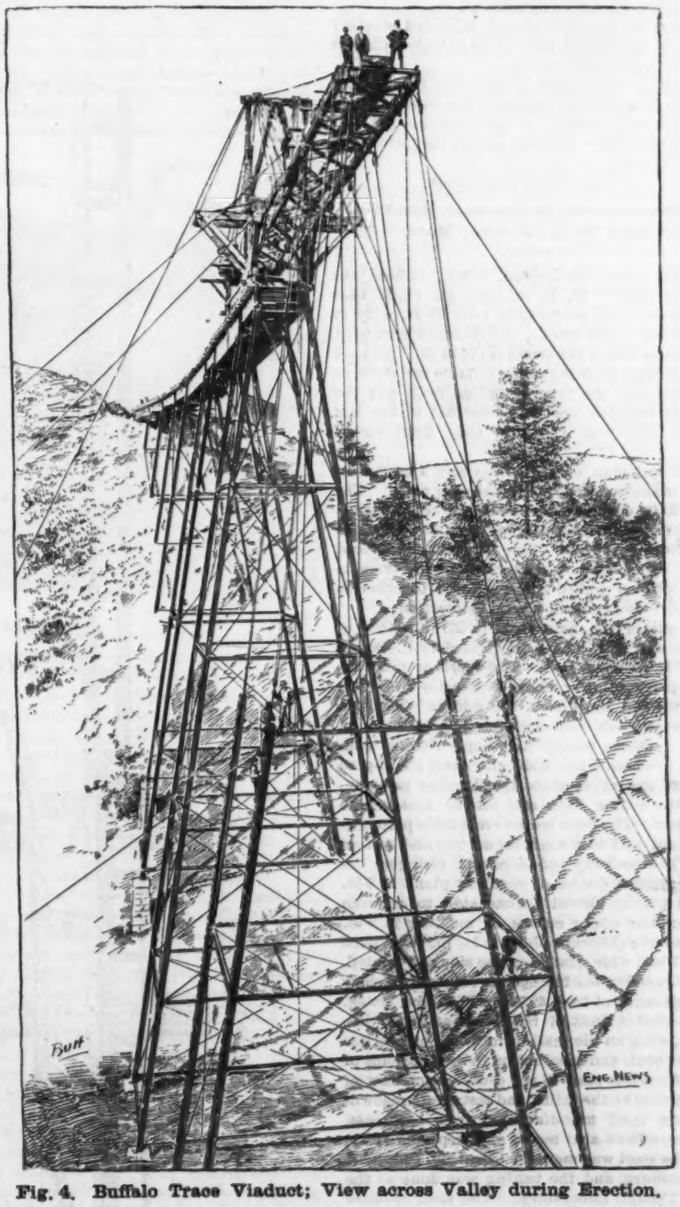
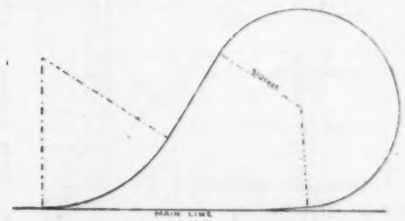


Fig. 4. Buffalo Trace Viaduct; View across Valley during Erection.

A Short-Radius Loop.

The sketch herewith given shows a loop of 310 ft. radius in use at Dunmore, Pa., on the Erie & Wyoming Valley Ry. Moguls, consolidations and ordinary engines run over it without difficulty, often at considerable speed. The gauge is 4 ft. 8½ ins., the radius of the curve is 310 ft., and the elevation of the outer rail is 6 ins. The loop was described by a correspondent in our issue of April 20.



Loop of 310 ft. Radius; Erie & Wyoming Valley R.R.

Spur Gearing.

The following series of spur gear conundrums is issued and answered by the Browne & Sharp Mfg. Co., of Providence, R. I. They will probably interest some of our readers, coming as they do from so good an authority:

Having the number of teeth and the diametral pitch, to obtain the pitch diameter, divide the number of teeth by the diametral pitch.

If the number of teeth is 40 and the diametral pitch is 4, divide 40 by 4, and the quotient, 10, is the pitch diameter.

Having the number of teeth and the diametral pitch, to obtain the whole diameter or size of blank, add 2 to the number of teeth, and divide by the diametral pitch.

If the number of teeth is 40, and the diametral pitch is 4, add 2 to the 40, making 42, and divide by 4; the quotient, 10½, is the whole diameter of the gear or blank.

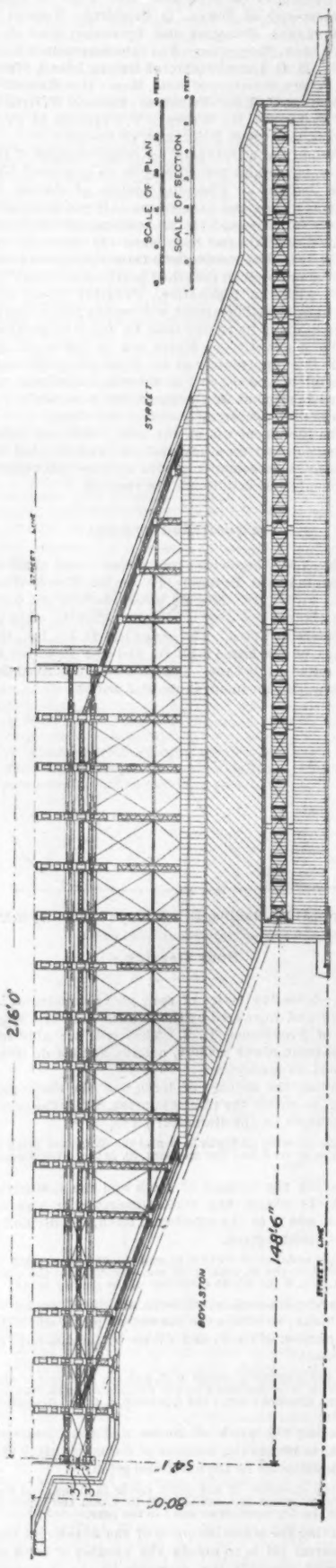
Having the number of teeth and the diameter of the blank, to obtain the diametral pitch, add 2 to the number of teeth, and divide by the diameter of the blank.

If the number of teeth is 40, and the diameter of the blank is 10½ ins., add 2 to the number of teeth, making 42, and divide by 10½; the quotient, 4, is the diametral pitch.

Having the pitch diameter and the diametral pitch, to obtain the number of teeth, multiply the pitch diameter by the diametral pitch.

If the diameter of the pitch circle is 10 ins., and the diametral pitch is 4, multiply 10 by 4, and the product, 40, will be the number of teeth in the gear.

Having the whole diameter of the blank and the diametral pitch, to obtain the number of teeth in the gear, multiply the diameter by the diametral pitch and subtract 2.



Boylston Street Bridge, Boston: Over Boston & Albany R. R. General Plan.

If the whole diameter is 10½ and the diametral pitch is 4, multiply 10½ by 4, and the product, 42, less 2, or 40, is the number of teeth.

To obtain the distance between the centers of two gears, add the number of teeth together, and divide half the sum by the diametral pitch.

If 2 gears have 50 to 30 teeth, respectively, and are 5 pitch, add 50 and 30 making 80, divide by 2, and then divide this quotient, 40, by the diametral pitch, 5, and the result, 8 ins., is the center distance.

Unless otherwise specified, the material used for gear is cast-iron.

If the hub is not mentioned in orders for gears, it is put on or not, as seems best to us.

Gears are not furnished with key-ways or set screws unless by special agreement.

In orders for gears it should be stated whether they are to be finished all over or not, also whether web or arm gears are wanted.

In ordering bevel gears, please give the number teeth, the largest pitch diameter, the width of face, the length and diameter of hub, and the diameter of hole; also state whether or not they are to be used as patterns.

The Boylston St. Bridge over Boston & Albany R. R., Boston, Mass.

Boylston Street, in Boston, Mass., crosses the Boston & Albany R. R. at such an angle that while the railroad property is only 60 ft. wide at right angles to the tracks, the distance measured on the center line of the street is 176.34 ft. No part of the railway property was available for piers or falseworks, and the type of bridge built and the method of erection are thus described in the last report of Mr. WM. JACKSON, City Engineer of Boston.

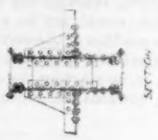
The general plan of the bridge and a section of the floor is shown in the accompanying plate. The street is 80 ft. wide, and in the bridge this width is divided by two trusses into one roadway and two overhanging footways. The trusses are placed 54 ft. 1 in. apart between centers, and each truss is made up of two arched trusses braced together so as to require no overhead lateral connection.

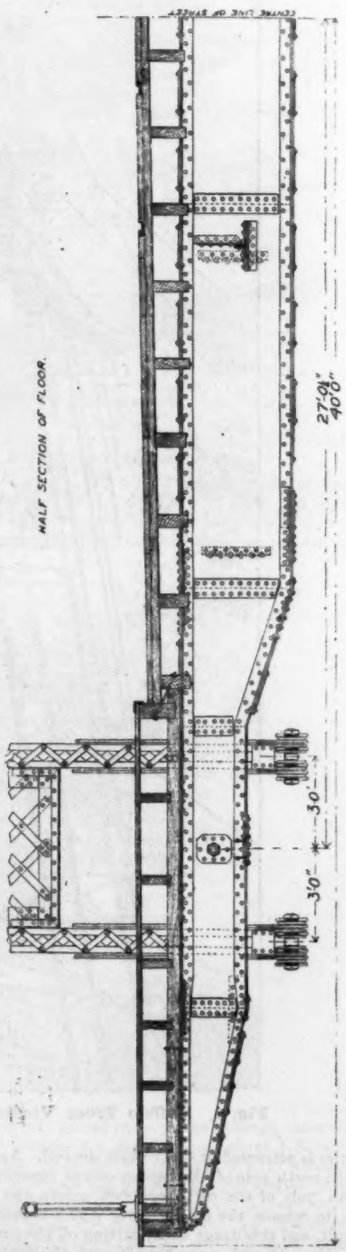
The length of the main truss is 216 ft. c. to c. of end piers, and this length is divided into sixteen panels of 13 ft. 6 ins. each. The depth of truss between upper and lower chord pin varies from 9 ft. 4 ins., at the end to 24 ft. at the middle. The pair of trusses on each side are placed 6 ft. apart on centers. In these trusses the upper chords, end-posts, all eye-bars 4 ins. wide and over, chord-pins and rollers are made of steel; all other parts, including the entire floor and lateral system, are made of iron. The floor-beams are double plate girders, latticed and tied together on top and bottom flanges. The roadway and sidewalk stringers are hard pine; under course of roadway plank is 3-in. hard pine plank, planed on one side to an even thickness; the upper course of roadway is 2-in. spruce, and the sidewalk plank is 1½ in. clear hard pine, 6 to 7 ins. wide, planed on one side and jointed.

The steel used in the bridge was required to show a tensile strength of from 62,000 to 70,000 lbs. per sq. in. and an elastic limit of not less than 35,000 lbs. per sq. in., with an elongation in 8 ins. of not less than 22 per cent. and a reduction in area at point of fracture of not less than 45 per cent. Each cast of steel was tested at the mills, and tests were made of the finished steel manufactured from each cast. All iron used was also tested and inspected at the mills. The steel was made by Carnegie, Phipps & Co., of Pittsburg, and the testing was done at the Pittsburg Testing Laboratory. The steel eye-bars were manufactured by the Edge Moor Iron Co., Wilmington, Del.

The erection of this bridge without the use of falseworks was carefully considered; but the railroad company, having consented to allow their tracks to be occupied by movable falseworks for a few hours on Sunday mornings, the contractor was enabled to carry out the plan devised and preferred by him. Each truss was erected on a staging at the side of and parallel to the tracks, one end of the truss resting on an abutment and the other end on a timber tower. Between the truss-shoe and the top of the tower were placed iron rollers, working between bars of railroad iron, and underneath the towers were wooden rollers resting on timber sills.

When the truss was connected, its abutment end was placed upon a hydraulic jack, and the tower-end swung about this jack, as on a pivot, to the opposite abutment, the tower moving by means of the wooden rollers on sills laid across the railroad track. When the tower had reached the abutment, the top of the tower was adjusted to the proper level by means of jacks, and the end of the truss



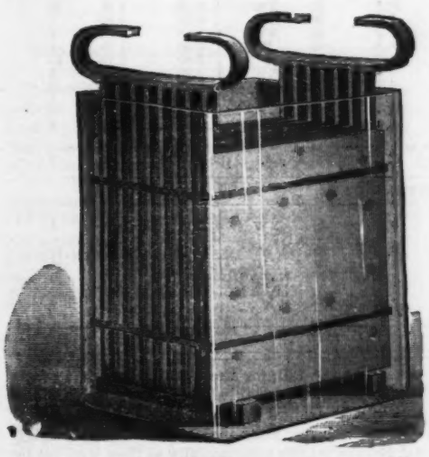


Boylston Street Bridge, Boston: Boston & Albany R. R. Half-Section of Floor.

moved on iron rollers and the rails to its proper place on the abutment. The trusses were swung into place in four hours' time for each, including the time spent in waiting for arrival and passage of trains on the track crossed. The design and detail plans for this bridge were prepared in the office of the City Engineer, and the work of building and erection was done by the Boston Bridge Works for $46,490.90.

Electrical Accumulators.

Briefly stated, the history of electrical accumulators is as follows: In 1801 GAUTHEROT discovered that two plates of the same metal immersed in acid, after having been subjected to the action of an electric current in one direction, would produce a secondary current in the opposite direction. This discovery suggested possibilities which were not realized until 1859, when GASTON PLANTÉ devised a storage battery made up of lead plates immersed in dilute sulphuric acid. This device was a success from a scientific standpoint, and when properly manipulated it would yield a high and steady electro-motive force and currents of a strength agreeing with the dimensions of the plates used. But an account of the large surface exposed to chemical action, its great weight, and the months of electrical treatment required to prepare the plates to receive any considerable charge, the invention was not commercially available. Then came CAMILLE A. FAURE with his discovery that a paste of oxide of lead mechanically applied to the plates brought them instantly into the condition to receive the charge, thus saving the months of preliminary treatment necessary in the Planté method. FAURE also materially decreased the size and weight of the battery and increased its efficiency and capacity. Certain imperfections in the Faure battery, chiefly of a mechanical character, have been since overcome by the later inventions of SWAN, SELLON, VOLCKMAR, SHAW, and others.



Electrical Accumulator.

The Electrical Accumulator Co., of 44 Broadway, New York, now offers to the public storage batteries which combine the invention of FAURE with what it claims to be the only valid and really valuable accumulator patents in force in the United States. One of these accumulators is here shown. It occupies a floor space of 9 x 11¼ ins., is 21 ins. high over all and weighs 121 lbs. It develops an electro-motive force of 2 volts, with a current of 30 amperes and a capacity of 300 ampere hours. The internal resistance is extremely low, or from .001 to .005 ohm, and the range of the current is large. There are fifteen plates in all, eight negative and seven positive.

The application of storage batteries, or accumulators, is an extended one. They can be used for electric lighting by the arc or incandescent method, for railway train lighting, stationary and locomotive power, electro-deposition of metals, in telegraphy, surgery, medicine, etc. Among its advantages the following may be stated: Wherever surplus power is available at odd times, electricity can be thus stored and utilized at pleasure; with accumulators electric light and power can occupy fields inaccessible to or independent of direct systems; water-power can be transformed into electrical energy by turbines and dynamos at any point, carried by wire to the place of use, and there stored by accumulators for subsequent use, and by this storage power it also renders useful electricity produced by variable or intermittent power.

For central station lighting, the Electrical Accumulator Co., before referred to, claims that it offers many advantages over direct lighting. The first cost for steam power is less; the power used is in direct proportion to the lamp load, as all surplus power is stored; the accumulators can be located so as to supply consumers 8 or 10 miles from a central station, and the running expense for a given number of lamps is less than with a direct plant for the reasons given. It is figured that the cost of a plant of 5,000 16 c. p. lamps, with 15 lamps per electrical horse-power, and an average service distance of 4,000 ft., would be as follows for the three systems named: Three-wire direct system, 12½ per cent. loss in main wire, will require 555 H. P., approximate cost of plant $27,750, and approximate annual cost of power, at $30 per H. P., $16,650. For the alternating system, 3½ per cent. loss in main wire, 555 H. P., plant, $27,750, annual cost, $16,650 For the accumulator system, 2½ per cent. loss in charging main, 300 H. P.; plant, $15,000; annual cost on same basis as preceding, $9,000. This comparison is based on a cost of $20 per H. P. for engines, $15 per H. P. for boilers, and $15 per H. P. for buildings. The great difference in annual cost arises from the fact that while the other two systems demand operation throughout the 24 hours to meet average requirements, in the accumulator system the power need only be used from 8 to 12 hours to store sufficient energy to supply light during the whole day. In other words, while the direct system is economical during the hours of greatest demand for light, it is very wasteful during the hours of moderate demand.

The accumulator furnishes a simple economical and efficient means of propelling street cars, doing away with the unsightly lines of poles and wires or the costly underground appliances of other systems. In this connection it has the decided advantage over the other systems of testing its merits by the simple equipment of one car, which may be run without a single change in the road-bed and without interfering with other motors already in use on the line. For car lighting it has already proved its many useful qualities, when used upon a scale sufficiently large to justify that common care and attention which any good system would demand. The Metropolitan Telephone & Telegraph Co., of New York, certify that they have been using 600 cells of the Electrical Accumulator Co. since early in 1887 and burning 500 incandescent lamps of 16 c.p. each 26 nights per month. They figure that they save, in night salaries of engineer and fireman, in fuel and wear and tear on machinery, $404.50 per month, or $4.854 per annum.

A Simple Boring-Apparatus Test.

Our late queries on the subject of the investigation of ground underlaying foundations, etc., are bearing fruit in the shape of various communications regarding this subject. As each case represents the experience of some engineer seeking knowledge, we hope to see the series still further extended; for the practical information thus given to the engineering profession fills, to some extent at least, a heretofore existing gap in the literature of engineering practice.

The latest method suggested for borings of moderate depths comes from a correspondent signing himself "Buckeye." He says he had frequently used for this purpose the following simple method: Take a worn-out locomotive boiler flue, and cut slots about ¾ in. by 6 ins. in a spiral winding around the flue. Then sharpen one end of the flue to a cutting-edge and put a heavy screw-cap on the other end. This cap should be not less than 3 ins. long and solid for 2 ins. of its length.

In using this testing apparatus, drive the flue down with a heavy sledge and at the same time turn the pipe with a large chain-tongs. The pipe can be lifted again by a lever or a derrick of portable form. When the tube is withdrawn, the character of the material penetrated can be examined through the slots in the sides. A locomotive boiler flue is generally about 11 ft. long, but this is usually sufficient to test the foundations of small bridges and other light structures.

PAPER TOUGH AS WOOD is said to be now made by mixing chlorids of zinc with the pulp in the course of manufacture. It has been found that the greater the degree of concentration of the zinc solution the greater will be the toughness of the paper. It can be used for making boxes, combs, for roofing, and even for making boats.

Wind Strains on the Sault Ste. Marie Bridge.

The designs for the superstructure of the Sault Ste. Marie bridge which were submitted by the various bridge companies were subjected to careful revision before being accepted. The calculations both for the swing bridge and the through spans were entrusted to Mr. W. B. DAWSON, assistant engineer; and in them some points of interest may be noted, especially with regard to the wind strains. The wind pressures specified were 50 lbs. per sq. ft. on the surface of both trusses, when the bridge is unloaded, and 30 lbs. on the surface of one truss and the train surface, when the bridge is loaded. In the case of the through trusses, the inclination of the top chord made the overturning power of the wind very considerable; and it was found that, owing to the length of the intermediate posts, they were not stiff enough to transmit directly to the bottom chord the pressure at the successive panel points of the top chord. The pressure on each half of the top chord, therefore, became concentrated as a reaction at the top of the end post, and had to be resisted directly by the portal and transmitted down the end posts themselves. The strains in the portal are not merely components of this reaction. For if P, Fig. 1, be its amount, it is resisted ultimately by the two equal forces $\frac{P}{2}$ acting laterally at the bottom of the posts. The portal has, therefore, to resist the tendency of the rectangle $AEFB$ to become an oblique parallelogram by pivoting around the points E and F, and the actual force R acting on the portal will therefore be, $R = P \times \frac{BF}{BD}$. With this value the strains in the portal were calculated, the form being that shown in Fig. 2, which has the advantage of being capable of definite calculation. The portal arranged as in Fig. 2 may be considered as capable of resisting internal deformation, and the form which the end posts will tend to take under the bending moment which still remains to be resisted can then be represented as in Fig. 3. The lower ends of the posts were considered as fixed

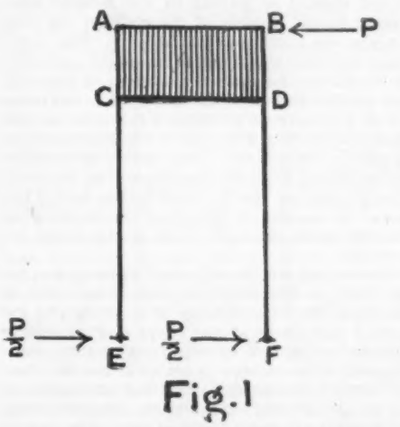


Fig. 1

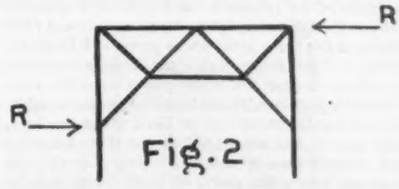


Fig. 2

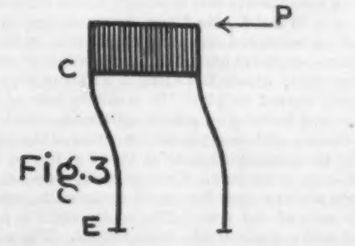


Fig. 3

also, as the bending is transverse to the end pins. The moments at C and at E are equal, and the amount of each represented by

$$\frac{1}{2} \times \frac{P}{2} \times CE.$$

The specifications allowed the combined strain from load and wind pressure, in members subjected to both, to exceed the normal strain by 25 per cent. To ascertain the actual maximum strain in the end post, the load was placed on the bridge in the position giving the greatest compression in the post; and from a simultaneous wind pressure of 30 lbs. the fibre strain at C was found. The additional amount of loading on the leeward truss, caused by the moment of the wind on the train surface, was also taken into account. The sum of these amounts was found to exceed the prescribed limit of strain for the post, as given by the modified Gordon formula of the specification; and it was found necessary to strengthen the posts by side plating, extending 9 ft. from C and E respectively, to prevent overstrain. This method of strengthening the end posts was first adopted on the 325 ft. through truss in the Ste. Anne bridge erected last year. It becomes an important consideration in through spans, especially when the top chords are inclined.

With regard to the amount of inclination of the top chord, a difficulty is sometimes met with at the angle formed on the top of the bridge, as the vertical component of the chord may be greater than the shear, and so cause one of the central diagonals of the bridge to act as a counter when the bridge is unloaded, making the adjustment of the bridge difficult. The design adopted in this instance gave as great a rise as was possible while avoiding this difficulty.

Massachusetts Water Power Practice.

The annual address of Mr. DESMOND FITZGERALD, president of the Boston Society of Civil Engineers, contains the following interesting account and comparison of the three great water powers of Holyoke, Lowell, and Lawrence, which we slightly condense.

In the development of water-power used for manufacturing purposes, Massachusetts stands second in rank among the States. New York takes the lead, and Pennsylvania stands third; but if we take the three great hydraulic centers, Holyoke, Lowell, and Lawrence, where the power of 35,000 horses is daily utilized from the flow of the Connecticut and Merrimac rivers, we shall hardly find their equal, as far as the scientific development of power is concerned, in any portion of the globe.

If Lawrence is smaller, as a water-power center, than either of the places mentioned, the works are simply and systematically designed, the mills compactly built in continuous lines along the river, and certain hydraulic problems have been studied which have not been considered elsewhere.

The water-power was developed by the building of the dam in 1845-8. Mr. CHAS. STORROW, one of the most accomplished engineers of his time in Massachusetts, designed and built the Lawrence works.

The dam, which has a length of about 900 ft., is slightly curved in plan. It is solidly built of masonry and founded on a hard slate rock, which has shown very little scour under the action of the waterfall. Its maximum height is about 40 ft. and it is 35 ft. wide at the base. From the dam there are two canals which convey the water to the mills, one on each side of the river. The south canal is quite short and comparatively unimportant. The north canal is a mile in length and nearly parallel to the river, discharging at its terminus into the Spicket river, at its confluence with the Merrimac.

Between this canal and the river are thickly clustered the celebrated mills which have given Lawrence a world-wide fame. The great Pacific mills, with 23 buildings, 160,000 spindles and 5,300 employés; the Atlantic Cotton mills, with 101,000 spindles and 1,200 employés; the Washington mills, with 2,660 employes; the Pemberton, Arlington, Everett, Lawrence Duck Company, with a host of minor corporations, all take their water from the canal on the one side and discharge directly into the river on the other.

The gate-house at the head of the north canal contains six sets of gates. Each gate is in four leaves, which are raised one at a time as the screw is turned, until all four are up. This work is done by hand-power. This kind of gate is no longer in use at either Lowell or Holyoke.

Each leaf is 3 ft. high by 9 ft. wide. A lock at the side of the gate-house allows the entrance of boats to the canal, and another set of three locks, at the other extremity of the canal, gives an outlet to the river.

The north canal is not rectangular in section. It is 100 ft. wide at the upper end, 60 ft. at the lower end, and has a depth of 12 ft. in the center. On the sides are two shallow walls, then a berme of 8 ft., and then slopes of 2 to 1 to the bottom. It will be noticed that the section is not a favorable one for measuring the flow of water. The fall of the water is about 6 ins. per mile. The head from the canal to the river averages uniformly about 28 ft. for its whole length, and this is the measure of the power at Lawrence.

The number of water-wheels is 59, of which 20 are Boyden, 14 Swain, 9 Hunt, 5 Risdon, 3 Hercules, 3 Victor, 3 Leffel and 2 National. This is perhaps a favorable place to say a word in regard to water-wheels. The old Boyden, at speed gate wide open, or running at full gate as it is called, has never been surpassed in duty by other wheels, but it is a poor wheel for economy when the speed gate is partly closed. There are several wheels now manufactured which are very much cheaper and which are better than the Boyden at partial gate. It is questionable, however, if any of them will prove as durable; for there are Boyden wheels now in use which have been running for many years with very slight repairs. Notwithstanding this fact, it is extremely doubtful whether many more Boyden wheels will ever be built. The advantages of procuring a more economical wheel in duty, for less than one-half the price, and ready made, like a pair of shoes, to put into instant service, are too apparent. Again, the exigencies of manufacturing often require an increase of power, and several of the modern types of wheel can be taken out and another inserted with the greatest facility.

There is now a movement toward horizontal wheels. These can, of course, be attached directly to the shaft which runs a mill without the intervention of heavy gearing and the consequent loss of power. Another advantage in the horizontal system comes from the avoiding of the wearing of the step. On the other hand, there are special difficulties in the horizontal system which have to be overcome. The draft tube which carries the water to the tail race must be perfectly tight to secure the benefit of the fall, for the slightest amount of air would impede the useful effect of the water. There are eight horizontal wheels in use at Lawrence.

In the Atlantic mills may be seen the four original Boyden wheels substantially as they were set by BOYDEN himself. They are still in use. In the Washington mills are 40-in. horizontal wheels. In the Everett mills can be seen an old 93-in. Boyden, and by its side a 54-in. Hercules, both fed by an iron penstock 8 ft. in diameter.

The finest wheel-room that I have found anywhere is in the Pacific mill. Here three Swain wheels are systematically geared to a large shaft. The belt well, where the power is transferred to the different floors, is worth visiting. The longest belt measures 250 ft.

Nowhere else has the problem of the accurate measurement of the flow of water supplied to the different mills received more thoughtful study than at Lawrence. Mr. HIRAM F. MILLS, the engineer of the Essex Co., has already made an enviable reputation for ability and care in this particular branch of hydraulic work. Although few of the Lawrence experiments have ever been published, it is expected that when the Lawrence hydraulic experiments are given to the world they will prove as interesting as the Lowell book, which is known wherever the science is studied.

The canal at Lawrence, as already stated, is poorly adapted to accurate measurements of flow. Aside from this fact, there is an objection to estimating in this way the surplus water to be paid for by the mills. Each corporation under its deed has the right to a certain permanent power, which forms perhaps, at any given time of measurement, the great bulk of the flow. The surplus, or the small percentage over and above this fixed amount, is the quantity which it is necessary to measure with the greatest possible refinement of method; and yet, owing to the difficulties in measuring precisely large quantities of water, the error of measurement may be the very sum which the mill may be called upon to pay. To get at the quantity supplied to any mill, from measurements made in the canal, two measurements are necessary, one above the intake to the mill, and the other below this point, the difference between the two giving the supply to the mill. Should, however, the errors both be in the same direction, the surplus of the mill might be largely affected. At Lawrence, the measurements are preferably made in the penstocks by one measurement, which gives the quantity flowing to each

Elements of Weather in the United States of most interest to Engineers, for the month of April, 1889.

STATIONS.	Temperature. Degrees Fah.				Wind velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average.	Max.	Direction at time of Max. Vel.	Total.	Heaviest in 24 hours.	No. rainy days
Northern Cities.										
Northfield, Vt.	42.7	76	18	58	7.1	40	W	1.10	0.27	12
Portland, Me.	43.6	66	26	40	9.0	36	S	2.39	1.24	11
New York City	50.7	80	34	46	9.7	36	SW	5.90	2.81	13
Pittsburg, Pa.	50.8	83	35	58	5.5	32	W	3.62	0.95	13
Chicago, Ill.	45.6	75	29	44	11.0	36	SW	2.35	1.08	8
Omaha, Neb.	52.4	80	32	48	9.5	43	NW	1.19	0.49	10
St. Paul, Minn.	47.0	76	26	50	8.6	30	W	1.14	0.52	10
Duluth, Minn.	40.2	70	22	48	7.9	34	NW	3.35	1.99	11
Bismarck, Dak.	47.8	85	20	65	10.0	70	W	0.26	0.11	4
Average	46.8	76.6	25.8	50.8	8.7	39.7		2.37	1.05	10.2
Southern Cities.										
Washington City	53.0	83	32	51	10.0	42	NW	9.13	3.21	18
Louisville, Ky.	56.7	85	29	56	7.2	30	SW	0.65	0.21	8
St. Louis, Mo.	56.5	84	30	54	11.2	42	NW	1.68	0.84	6
Savannah, Ga.	62.0	86	42	44	6.9	36	W	2.36	1.23	7
Leavenworth, Kan.	54.9	89	30	59	6.9	30	S	2.80	0.70	13
Jacksonville, Fla.	65.6	88	44	44	5.4	33	NW	3.95	3.52	5
Chattanooga, Tenn.	60.2	86	37	49	6.3	36	NW	3.21	1.83	8
New Orleans, La.	70.2	88	54	34	8.1	30	S	2.28	1.79	5
Memphis, Tenn.	61.8	83	41	42	6.6	36	NW	3.47	1.33	9
Palestine, Tex.	67.5	87	50	37	6.0	29	W	2.31	0.72	8
Average	60.7	85.9	38.9	47.0	7.5	34.4		3.18	1.54	8.7
Western Cities.										
Helena, Mont.	48.2	76	25	51	6.3	42	NW	0.11	0.04	4
Port Angeles, Wash.	Not yet received.									
San Francisco, Cal.	56.5	77	49	28	8.6	30	W	0.96	0.30	11
Salt Lake City, Utah.	55.2	83	32	51	6.6	38	NW	1.52	0.68	10
Denver, Col.	49.8	78	29	49	8.0	48	NW & N	1.34	0.57	10
Yuma, Ariz.	73.4	104	46	58	7.0	38	NW & N	0.00	0.00	0
Santa Fé, N. Mex.	49.4	75	26	49	7.8	32	N	0.44	0.26	6
Average	55.4	82.2	34.5	47.7	7.4	37.3		0.73	0.31	7.3

wheel as a check on the flow computed from the head and fall at each wheel. The measurements in the penstocks cannot be done by the ordinary methods pursued by engineers, and this led to the use of the Pitot tube, which has been so modified and perfected that all the heads due to velocities in different portions of a section are brought up to one keyboard, where they can be conveniently read. This portion of the hydraulic problem is *the* feature of the Lawrence methods, and its development will be watched by all engineers with interest.

A pleasing feature connected with the construction of the Lawrence mills is the location of the tenement houses for the employés. They are situated on the opposite side of the canal to the mills, are built of brick and surrounded with shade trees, making an interesting, out of what is too apt to be an ugly part of the landscape, in a manufacturing center.

A mill power at Lawrence is the right to draw 30 cu. ft. per second for 16 hours on a fall of 25 ft.

(TO BE CONTINUED.)

The Canadian Pacific's Annual Report.

The active discussion concerning "Canadian competition," which is now in progress, makes the annual report of this company one of especial interest. The following shows the results of operations for three years:

	1886.	1887.	1888.
Gross earnings	$10,081,803	$11,606,412	$13,195,535
Operating expenses	6,378,317	8,102,294	9,324,760
Net earnings	$3,703,486	$3,504,118	$3,870,774
Fixed charges			3,544,351
Surplus			$326,423
Receipts per pass. mile		1.98 cts.	1.79 cts.
" " ton-mile		1.06 cts.	1.02 cts.

These results were not quite equal to what the management had expected. This is ascribed to the light crops in Ontario in 1887, the bad harvest in Manitoba in 1888, and the delay in the completion of the Duluth, South Shore & Atlantic and Minneapolis, St. Paul & Sault Ste. Marie roads, to meet the Algoma branch at the Sault. The latter of these roads is to be opened for through passenger traffic on June 2, and the other very soon thereafter. The extension across the State of Maine was also delayed by bad weather and difficulties of construction, considerably increasing its cost over the estimates. It will be formally opened for traffic on June 2.

The development of traffic in the newer districts traversed by the system is said to be exceeding all expectations, and the directors are now confident that even what seemed at first the most unpromising sections will soon become self-sustaining. The town sites along the line have thus far brought the company over $1,400,000; and as but a small part of this company's interest in them has been disposed of, it is believed that this will be a great and increasing source of future revenue.

Much work has been done in replacing wooden bridges and trestles along the line between Lake Nipissing and Winnipeg with permanent structures or embankments; and it is intended to complete the work as fast as possible. The extensive snow sheds, begun three years ago, were finished during the past year. During the past winter the transcontinental trains arrived practically on time. One detention of 13 hours occurred, but was not due to snow or stress of weather. The improvement of the various lines worked by the company, the increased facilities provided, and the large number of very heavy locomotives added to the equipment during the year, favorably affected the working expenses of the past seven months. On some sections of the line the number of freight cars to a locomotive has been fully doubled.

NEW CONSTRUCTION.

The "short line" to the Maritime Provinces is finished, as already stated, to Mattawamkeag, Me.; and an agreement has been reached with the Canadian Government for the construction of the section from Harvey to Moncton, N. B., about 115 miles, whereby the Government agrees to build the line, the company to work it for 30 years without rental. Thereafter a rental of $73,400 per annum is to be paid. The agreement only awaits ratification by Parliament to go into effect.

The western entrance to Montreal and the new passenger station are practically completed, and have been in partial use for two months. The eastern entrance to Toronto and the line along the lake front in that city will be ready for use before the end of the summer. The report continues:

The extension of the Ontario & Quebec Railway (under perpetual lease to this company) from London, Ont., to the Detroit river is advancing rapidly, and the line will be ready for traffic before another winter. This line will connect at Detroit with a number of important railways, extending to Chicago, St. Louis, etc., and will at once enable the eastern lines of the company to command a large and profitable traffic, from which they have hitherto been debarred. An attempt was made to secure the use of one of the existing railways for the purpose of reaching the Detroit river, but this could not be done except under conditions to which your directors felt it would be most unwise to submit.

Aside from the Detroit extension and the eastern entrance to Toronto, the only new work now in hand is a branch of 10 miles from Mission, B. C., 43 miles east of Vancouver to the international boundary, to connect with a railway that is being made by an independent company, extending southward to the important city of Seattle on Puget Sound. This short branch is the last link in the chain of railway connections along the Pacific coast from the Canadian Pacific Railway to the Gulf of California. The construction of this line will add largely to the through business of the Canadian Pacific, which has heretofore been unable to reach the cities of the Pacific coast except by water from Vancouver.

PROJECTED EXTENSIONS.

Surveys were made a year ago to secure a direct line between Sudbury Junction and Toronto to avoid the roundabout route via Smith's Falls. A favorable route was found from a point near Sudbury to Kleinburg, near Toronto. By the construction of 212 miles of new line with easy grade and good alignment, the distance between Toronto and Sudbury could be reduced to 238 miles against 528 miles via Smith's Falls. A traffic agreement has been closed with the Grand Trunk company, however, by which the construction of this road is obviated for the present, and it is hoped for a long time to come.

The connections necessary to the full completion of the system are now few in number. The most important are between Toronto (or Cooksville) and Hamilton; Hamilton and Niagara Falls, and Hamilton and Woodstock, requiring short lines of 30, 42 and 47 miles respectively. The South Ontario Pacific Railway Co., a friendly organization, is likely soon to provide these connections. The construction of these short lines will give the company independent access to Hamilton, Brantford, Dundas, St. Catharine's, and Thorold, and at the same time afford a much-desired connection between the independent American railways centering at the Niagara Falls and those west of Detroit, and an urgently needed connection between the Canadian Pacific lines and those leading to New York from Niagara Falls and Buffalo.

The only other connection that remains to be established is one from the south end of the St. Lawrence bridge, near Montreal, southwesterly to a junction with the Rome, Watertown & Ogdensburg Railway near Dundee. This line, 55 miles in length, is proposed to be constructed by the Southwestern Railway Co., another friendly organization, and will extend through a chain of towns on the south bank of the St. Lawrence river, and afford to the lines east of Montreal a direct connection with central and western New York.

It is considered highly desirable that a branch line of about 100 miles should be made as soon as practicable from Brandon, Man., southwesterly to the Souris coal field. The country along the Souris river is already well settled, and is suffering for want of railway facilities; and the early construction of the line is necessary, besides, for the protection of Canadian Pacific interests in southwestern Manitoba.

THE LAND GRANT.

The company's land sales for 1888 were 138,000 acres for $443,526, an increase of 156 per cent. in the acres sold and 146 per cent. in the amount realized over 1887. The report says:

Notwithstanding the increase in the number of acres sold in 1888 over 1887 (156 per cent.), the increase for the first four months of the present year over the corresponding four months in 1888 has been 162 per cent. The following was the position of the land grant Dec. 31:

	Acres.	
Original grant	25,000,000	
Surrendered to Government under agreement of March 30, 1886	6,793,014	
	18,206,986	
Sales to Dec. 31, 1888	3,410,750	
Less, canceled in 1888	11,300	
	3,399,450	3,399,450
Quantity of land unsold		14,807,536

In addition, the company holds 1,309,424 acres of lands in Southern Manitoba, which came to it by the purchase of the Manitoba Southwestern railway. These lands are among the best and most available in the Northwest, and at the average of the sales last year, $4.54 per acre, their value is $5,944,785. They are subject only to a lien of $884,873 in favor of the Province of Manitoba. They are expected to yield at least $5,000,000 over and above the amount due to the Province.

In comparing the Canadian Pacific with other railways in Canada and the United States, the great and increasing value of its lands should not be overlooked. These lands have been selected with especial reference to their agricultural value, and at the average of last year's sales, and including the Manitoba Southwestern lands, will yield more than $55,000,000, an amount sufficient to pay off the land grant mortgages, as well as the whole of the first mortgage bonds of the company, nor in such a comparison should it be forgotten that the profits from the telegraph, sleeping cars, express, grain elevators, lake steamers and other similar adjuncts of the railway service, which on nearly all other lines are given over to private parties or corporations, are, in the case of the Canadian Pacific, preserved to its shareholders; and their value is shown by the fact that the profits from them last year amounted to about one-third of the interest on the first mortgage bonds of the company, notwithstanding that it was only the second year of the sum of full operations.

On moving the adoption of the report, President VAN HORNE made some statements concerning the relations between the Grand Trunk and the Canadian Pacific Railroad, and the very bitter remarks in reference to the latter company which are made at the Grand Trunk shareholders' meetings. He was followed by Sir GEO. STEPHEN, who spoke in the same strain. The dignified but scathing answers which these gentlemen made to the charges of Sir HENRY TYLER indicated that the Canadian Pacific managers are well able to hold their own against their rival.

Mechanical Stone Cutting.

Among the exhibits at the Paris Exposition is the stone-cutting machinery of M. PAULUS GRAY, of Marseilles. The so-called saw is an endless wire cord, or a single wire twisted upon itself. This wire merely serves to draw along the wet sand, which really does the work. This method is used exclusively in two marble quarries in Belgium, and is at work in other parts of Europe on various kinds of stone, including granite.

In practice, a cord about ¼ in. in diameter is used, traveling at a speed of about 13 ft. per second, a smaller cord and increased speed being used for a simple subdivision of blocks. The twist in the cord causes it to turn as it cuts, thus wearing the whole surface evenly, until it is smooth. Before being worn out, a cord 450 ft. long is capable of cutting to a depth of 70 ft. in 15 ft. blocks, or of producing about 500 sq. ft. of sawn surface in marble. In a marble block 15 ft. long, the cut is at the rate of 4 ins. in depth in one hour; in granite it is 1 in. in the same time.

One endless wire, guided by grooved pulleys, may be made to cut at several different places not too near together. The tension is maintained by a loaded truck on an incline, and the driving power required is slight, as there is so little surface in contact. The feed is controlled by an automatically operated screw in stone of even texture, or by hand in other cases. In the Traigneaux quarries 14,000 cu. ft. of marble are produced annually by 30 men and 5 boys, who feed the machines. The patents are held by the *Société Anonyme Internationale du Fil Helicoïdal*, Brussels, Belgium.

THE HAWKESBURY BRIDGE in New South Wales was officially opened in May by the Governor of that colony in the presence of the Ministers members of Parliament and the public. This is the bridge built by the Union Bridge Co., of New York, in competition with the world's bridge builders and for a sum absurdly low as compared with British estimates of cost. It completes the railway communication between Brisbane and Adelaide and is the largest bridge in the Southern hemisphere, with its seven spans of 415 ft. each.

ENGINEERING NEWS

AND

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Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club, Philadelphia, Pa.—Regular meeting, June 1. Secy., Howard Murpoy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Regular meeting, June 3. "Sewerage for O. K. Creek District," W. Kierated and A. J. Mason. Secy., Kenneth Allen, 310 Baird Building.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting, June 3. Secy., Geo. L. Wilson, Asst. City Engineer.

Denver Society of Civil Engineers.—Regular meeting, June 4. Secy., W. W. Follett, Tremont Block.

Western Society of Engineers, Chicago, Ill.—Regular meeting, June 5. Secy., John W. Weston, Gaff Building.

Engineers' Club of St. Louis, Mo.—Regular meeting, June 5. "The Olive St. Cable Line," W. Bartlett; "Compound Engines," E. E. Furney. Secy., Wm. H. Bryan, 709 Market St.

American Society of Civil Engineers, New York.—Regular meeting, June 5. Annual convention at Seabright, N. J., about June 20. Secy., John Bogart, 127 E. 23d St.

Association of Civil Engineers, Dallas, Tex.—Regular meeting, June 7. Secy., E. K. Smoot, 15 No. Jefferson St.

Civil Engineers' Club of Cleveland, O.—Regular meeting, June 11. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass.—Regular meeting, June 12. Boston & Albany passenger station.

New England Water-Works Association.—Annual meeting at Fall River, Mass., June 12, 13, 14. Secy., R. C. P. Coggeshall, New Bedford, Mass.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, June 18. Secy., S. M. Wickersham, Penn Bldg.

American Railway Master Mechanics' Association.—The annual meeting will be held at Niagara Falls, N. Y., beginning June 18. Secy., Angus Sinclair, 160 Nassau St., New York.

Boston Society of Civil Engineers.—Regular meeting, June 19. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, June 20. Rooms, 113 Liberty St., New York City.

Master Car-Builders' Association.—The annual meeting will be held at Saratoga Springs, N. Y., June 26. Secy., J. W. Cloud, Buffalo, N. Y.

THE circular of the Interstate Commerce Commission, published in another column, marks the beginning of what is destined to become, in our judgment, important and decisive action looking to the introduction of railway safety appliances, as notably, train brakes, automatic couplers, and steam heating. The circular is issued in pursuance of the resolutions adopted at the late Washington convention, and merely asks views as to (1) whether federal regulation of these matters is desirable; (2) if desirable, what it should attempt to accomplish; and (3) through what special administrative agencies, if any, it should be accomplished.

Under its constitutional authority "to regulate commerce between the States," Congress has the undoubted authority to enforce the use of any and every safety appliance which it may judge necessary; and if there is a field where it would seem not only proper but necessary for Congress to take such action—albeit by something of a departure from the wise conservatism of the past—it is in the field of such safety appliances for railways as require uniform concurrent action throughout the United States to be effective. Our railway system has so utterly outgrown State limits and State regulations, in such matters as this especially, that attempted State action may easily do more harm than good, for lack of harmony between the States. Moreover, so unified has our railway system become, that although there are still a few lines wholly within the limits of a single State, yet there is hardly one of them which is not engaged in "interstate commerce" to such an extent that regulations fixing requirements for engaging in such commerce would practically apply to every railway, long or short, within our national limits.

THIS being so, we believe that some simple legislation such as the following would accomplish every desired end without the creation of any cumbrous machinery to enforce it. We make no attempt to choose precisely the right phraseology, but merely to give in a few words the necessary substance:

Art. 1. Whenever the Interstate Commerce Commission shall become satisfied from evidence submitted to it or obtained by due inquiry that any automatic car coupler, automatic train brake, coupler for steam heating, or other uniform safety appliance has been approved and recommended by any representative body of railway officials as a general standard for a period of not less than two years; and it shall further appear to the satisfaction of the Commission, after due investigation, that the standard so selected is a good and proper one, and that the wisdom of its selection is not so controverted as to make a reversion of such action probable and expedient, it shall be the duty of said Commission to formally announce such fact by circular to all the railways of the United States engaged in interstate commerce.

Art. 2. After the expiration of one year from the date of said notice it shall be unlawful for any company to construct or refit by general repairs any cars for its use which are not provided with the standard appliances so approved by the Commission, *provided* [certain provisions for appeal during the probationary year; and for postponing the date when this article shall go into effect in case of appeal.]

Art. 3.—After the expiration of 7 years from the date of said notice, it shall be unlawful for any company engaged in interstate commerce to run any cars in any of its trains which shall not be provided with the standard appliances so approved by the Commission, *provided* [certain discretionary provisions for delay.]

Art. 4. [Provisions giving the Commission discretionary powers to establish a standard of their own motion in case of unnecessary delay by representative railway bodies, after due notice to such bodies, to appoint special expert boards for this purpose, etc.]

Art. 5. [Penalties and provisions for enforcement through the courts, etc.]

This would afford a period of 9 years from the final adoption of a standard by the Master Car Builders' or any other analogous association before it would have to be in use on all cars, and a period of 3 years before it would have to be put on all new cars, which is long enough to involve no hardship in any case; while its inevitable effect would be to bring the adopted standards into all but universal use in a much shorter time, since it would give railway officers what they now lack, *certainty* that any action which they might take in conformity with recommendations of the M. C. B. or other association would not be practically useless for years for lack of similar action by other companies. At the same time such a law leaves the selection of standards where it belongs, in the hands of railway officials themselves.

THE automatic coupler standard is already so fixed that it might be promulgated under such a bill immediately after its passage. The automatic brake question is not so far advanced in form, although it is quite as far advanced in fact. The predestined standard seems to be the Westinghouse, but this very fact makes action by the M. C. B. Association embarrassing, since it involves—what was not at all involved in the standard coupler action—standardizing a proprietary device, and that device one which is incapable of joint use with various other devices, like the Eames automatic vacuum, which have cost a good deal of money to perfect, and which claim certain important points in their favor. All that it would be really necessary to standardize, however, would be "the Westinghouse or any other train brake capable of interchangeable use with it in the same train and with the same couplings and air pressures." In our judgment, the hour cometh and now is when such action is proper in the interest of humanity, despite the real and obvious objection to so endorsing a single device. It is also highly desirable to standardize some form of uniform coupling for steam heating, after doing which, fortunately, the whole question of applying and distributing the heat may be left to individual action without further effort at uniformity.

A CORRESPONDENT asks us: "Can you inform me what was the fastest time made on any railway previous to 1840?" We regret to say that we cannot absolutely, especially as respects this country; but it was nearly as fast as has been made since. The fastest was probably BRUNEL'S run on his 7-ft. gauge Great Western Railway, made about 1840, which was at the rate of nearly 60 miles per hour for over half an hour, and was at the time regarded as the most remarkable ever made. Still, a number of engines, both English and American, had by 1840 attained about 50 miles per hour for short runs. The railway system of England was then (1841) only 1,650 miles, and in this country 3,531 miles, and speeds were still usually slow even in England, and yet slower here. Some of the very earliest records showed remarkably good speeds, as will appear from the following list of a few of them:

July 1829.	Peter Cooper's small locomotive of 1.43 H. P. 13 miles in one hour, 18 miles per hour max.
Oct. 1829.	*Rocket*, 35 miles at 29 miles per hour.
1830.	Northumbrian, driven by STEPHENSON and carrying HUSKISSON, 15 miles at 36 miles per hour.
1831-2.	Five or six different American built and designed engines made 30 miles per hour, but none surpassed the *Rocket* record.

After 1832 locomotive practice rapidly improved, and as respects speed touched its maximum in about ten years. Thus the *Railway Times* of Dec. 7, 1843, gives a run of three successive miles, authenticated by three different timers, as 53, 54, and 55 seconds, an average of 66⅔ miles per hour. In 1842 Queen Adelaide was carried 78 miles in a minute less than 2 hours, which was regarded as a great achievement, and shortly after the same run was made in 1 hr. 46 min., or at 46 miles per hour. In 1843 23 miles was run in 25 minutes, and runs of 60 to 65 seconds per mile were not at all uncommon. Even in this country, runs approaching that speed were made about that time, and practically there has been no increase in maximum speed in the last 45 years. The gain has been in hauling power and economy.

THE nail is hit on the head pretty well in a brief note which forms part of a private letter from Mr. BENJAMIN BAKER, of the Forth bridge, as follows:

It is clearly necessary to provide for the contingency of a train accident on a bridge. What would be said of ship-builders if they allowed a little extra expense to stand in the way of water-tight bulkheads?

The sooner that bridge builders and bridge buyers recognize the truth embodied in this brief sentence, the better it will be for all concerned, and for our national standing as bridge builders, which is very injuriously and unfairly affected by the practice of too many of our engineers and builders of skinning down strain sheets until the span, not oversafe even when first put up, from the joint effect of vibrations and of constantly increasing loads and speeds, becomes unserviceable long before it has lived out half its proper life. The primary fault, as we have often said, lies with the buyers of bridges, in encouraging a competition in cost which compels such skinning as the only alternative to getting little or no work; but all engineers should do what they can to discourage such practices. Already, we learn, one great road at least has now under contemplation a further increase in assumed loads by specifying 10 tons per wheel as the typical load for Consolidation engines. This load once established *de jure*, no one can doubt that it will soon be established *de facto* likewise, and this means a further scrapping of many bridges before they are fairly erected.

IRRIGATION VS. RAIN is the subject of a late publication sent out by the Salt Lake City Chamber of Commerce. Utah is mainly a rainless region so far as any successful farming is concerned, and artificial irrigation is therefore necessary. But, contrary to the general opinion, the Salt Lake City commercial authorities recognize this lack of rainfall as a blessing rather than a disaster, and make out a very plausible case to show the agricultural advantages of artificial irrigation. They put the maximum cost of this irrigation at $3.50 per annum per acre, with water applied when the crops most need it, and withheld when water does no good. They then contrast this control of the useful element with the vagaries of natural rainfall, and the vicissitudes of alternate droughts and floods. And there is a strong element of truthfulness in the assumption of the Salt Lake merchants, for even in the East, with its forty odd inches of rainfall, the majority of farmers would be doubtless much better pleased if they could control the down-pour. Prayers for rain at one season are too often followed by deep and earnest growls at the vigor and persistency of answering showers. There are doubtless advantages in artificial irrigation when this can be economically secured.

WE devote a considerable space this week to an unusually full practical description of what may prove to be one of the most notable achievements of the end of this century, a successful mechanical type-setting machine. The New York *Tribune* has taken a leading and important part in the development of such machinery, and it looks very much as if success had been won at last. The *Tribune* is to-day one of the neatest and most attractive papers typographically in the world, and the fact that it is now practically all set up by machine, only 4 hand compositors being employed for setting up head lines, etc., whereas over 100 would otherwise be needed, is the best of all certificates to the practical working of the machine.

The "art preservative of all arts," by a strange anomaly, is almost the only great art of which it can be said that its processes have remained practically unchanged for over four centuries since its first invention. The types themselves are better made, and the process of printing from them has advanced enormously; but the process of "composing" the type into words is practically identical with that used when the first of all types were made. This obvious anachronism has turned keen minds upon the problem of mechanical type-setters for over half a century, and the number of machines which have been invented and tested is already great (about 160 in this country alone); but if we may believe that the "linotype" is the true type for such machines, most of those which have been heretofore invented were doomed to failure from the first. The first idea was naturally to use separate types for each letter, as in hand composition; but "justifying" (spacing out each line properly) and distributing proved insuperable obstacles. The next was to stamp a matrix from which a casting could be made. This also has proved unsuccessful; as has also casting each type separately as needed. The last and now successful plan is to put molds of hard metal together line by line; justify by an ingenious wedging system; take a casting of the line at once, and immediately and automatically redistribute the type again while a new line is setting up. So far as the compositor is concerned, the process is strictly analogous to that of running a type-writer, and requires no longer training or greater skill.

The effect of such mechanical composition, if it continues successful, may possibly be very great. It is quite certain to heavily reduce the cost of printing, while affording better wages for employés. Considering how very new the invention is, further material improvements may reasonably be expected; and even as the machine now is, it is likely to open a new and wide field for the further employment of women.

IN lately describing the drifting test for steel "as devised by Messrs. Hunt & Clapp," we referred rather to the extent to which the test had been carried out by them than to originality in the method itself. As a matter of fact, the drifting test, applied in a more or less crude and limited form, has been known for a number of years. Messrs. Hunt & Clapp write us that they make no claim whatever for originality in the drifting test, but that as a test it has been used by them for a long time. The interesting communication of Mr. THEODORE COOPER, published in this issue, also shows that his attention was favorably attracted toward the same tests "some years ago," and that he had since advocated its use and induced Mr. CROES to insert it in his girder specifications.

THE conclusion of our review of the Northwestern Railway systems, describing the minor systems of the Northwest, we are obliged to postpone to another issue.

Various Systems of Car Lighting.

We publish in another column a communication in reference to the "dry carburetter" or gasoline system of lighting cars, in answer to our own comments on the Pennsylvania Railroad regulations for the use of it, in our issue of May 11. It will be seen that the company claim that these regulations, in the effort to make all employés properly cautious, lay much more stress on the dangers to be guarded against than is really necessary; and they also state that the Pennsylvania road is no longer "experimenting" with the device, but has definitely adopted it for its entire equipment, and is applying it to all its cars as fast as possible. We have not so understood the present status, but we accept and present the company's statement.

The letter is accompanied also by an advance-proof of a new circular and catalogue, giving a very full explanation of the apparatus. As we have already given our view of the use of gasoline for general car lighting, which was and still is anything but favorable, it seems only fair that we should give the other side of the question, as set forth in this catalogue, which we proceed to do as fully as may be in our limited space.

On what is apt to be regarded as the vital question of cost, the company puts forth the following comparison, which we condense into tabulated form, and add, in the last column, a quantity very necessary for easy comparison, viz., the cost *for an equal light* of 240 candle power per car per hour. Of course, by any system, it is possible to obtain equal light, if desired, by adding lights, and the true quantity to consider, therefore, is the cost per unit of light.

The five systems compared are (1) lighting by oil lamps, (2) by compressed coal gas, (3) by compressed oil-gas, (4) by electricity, and (5) by gasoline. The respective candle-powers obtained by these systems are assumed to be 35, 60, 150, 100, and 240; or, taking the ordinary gas flame as representing 15 candle-power, $2\frac{1}{2}$, 4, 10, $6\frac{2}{3}$, and 16 gas burners respectively. This probably represents fairly well the actual light which has been most common with each system; but it is obvious that any system may be made to give any candle-power by multiplying lights, and that expenses will not increase nearly in direct ratio. We assume, however, that they will so increase in preparing the last column below:

	No. of lights.	CANDLE-POWER Each light	total c. p.	COST PER HOUR actual cost, cts.	for 240 candles, cts.
Kerosene oil	6	6	35	6	41
Compressed coal gas	6	10	60	15	60
Compressed oil gas	5	30	150	5	8
Electricity	10	10	100	80	192
Gasoline	6	40	240	3	3

It is but reasonable to suppose that this table does not err against the gasoline system of lighting by understating the cost of the first four systems of lighting, although the contrasts they present are somewhat remarkable. The price given for gasoline lighting is stated to be based on a cost of 17 cts. per gall. for gasoline, the actual price ranging from 13 to 20 cts. On this basis, a gallon of gasoline is capable of giving out $\frac{17}{3} \times 240 = 1{,}360$ candle-power hours. As a gallon of sperm oil, burned under the most favorable conditions, gives only 600 candle-power hours, and as the mean is only about half this, we are unable to see how an inferior illuminant like gasoline can give 2 to 4 times the light per gallon, and think there is some error here.

On the other hand, the price of good kerosene oil, of 350° fire test, is now only 13 to 20 cts. at retail, or precisely the estimated cost of gasoline. Is gasoline a superior illuminant to kerosene, gallon for gallon? We know of no evidence to support this view, but rather to the contrary. If not, it is difficult to see how an estimate of nearly fourteen-fold cost for kerosene can be correct, from any point of view; for maintenance of lamps and of gasoline apparatus ought nearly to balance each other.

Again, the established standard for coal gas is that 5 cu. ft. per hour shall give 14 candle-power, which would require for 240 candle-power, $\frac{240}{14} \times 5 = 86$ cu. ft. per hour nearly. At $2 per M. ft. this only amounts to 17.2 cts. per hour (to which is to be added the cost of compressing) instead of 60 cts. above.

As for electrical lighting, the art is yet too young to permit of any exactitude in estimates. That it is more costly than any of the other methods, we believe. It is certainly better; and energetic claims are advanced that it is really cheaper. That there is necessarily any such great difference as the figures show, we cannot believe.

Burning sperm candles at 20 cts. per lb., the cost of 240 candle-power would only be 120 cts. per hour. An established comparative ratio for equal light (we do not say an exactly correct ratio) is 12 cu. ft. gas= 1 lb. candles. At this rate only 73 cu. ft. of gas would be required, costing 14.4 cts. per hour. How much cheaper oil gas is than coal gas for equal light we cannot say; the above table, with unusual generosity (considering that oil gas is a rival system of lighting), shows it to be 7½ times cheaper. It is undoubtedly cheaper, but that it should be so much cheaper as the above table shows it to be (8 cts. per hour per 240 candle-power) we know of no reason for believing.

On the whole, the statements of comparative cost which we have quoted seem decidedly erratic; so much so as to be quite untrustworthy. We proceed now to summarize the ingenious methods by which the admitted dangers of gasoline, improperly used, are claimed to have been eliminated, so as to make the system the safest as well as the cheapest.

In the first place, a supply of compressed air is taken from the brake valves, stored in a receiving tank, and fed to the carburretters through a reducing valve at 3 lbs. pressure. The carburetters are outside of the car, on the roof, and contain a spiral chamber about 40 ft. long, filled with wicking to absorb the gasoline, so that it is claimed that there is never any fluid to run out even if the carburetters were pierced. A check-valve and dust-screen are introduced to prevent air flowing back into the train pipes from the receiver, and to eliminate all dust from the air supply. A mercurial seal, opening at 3 lbs., prevents any over-pressure in the carburetters from throwing gas back into the pipes.

The carburetter is a round, flat, seamless copper box, tested to 30 lbs. pressure, directly above the lamp, with a hole in the center through which the air supply is admitted. The air which is to be charged with gasoline vapor first passes through a coil pipe directly above the lamp, so as to be heated as nearly as may be to a uniform temperature, winter and summer; and hot air from the car also circulates in an air chamber around the outside of the carburetter. This uniformity of temperature is very necessary, because the ability of the air to carry gasoline vapor is very different at different temperatures.* A permanent cross connection dilutes the charged air with more air, "thus preventing any possibility of too rich or smoky a gas reaching the lamp," which is stated to be otherwise possible when the carburetters are freshly charged or the air very warm.

From the carburetter the charged air passes directly downward to the lamp beneath. A needle valve regulates the supply, and cannot be opened until a glass globe closing it from the air from below is in place. The air for combustion is taken in from above.

A charging can, holding about 2 galls., is used to fill the carburetters. It has three openings, all of which are first closed, to begin charging. One of these openings is only used to fill the can with gasoline. To charge the can is at first turned bottom upwards; the central opening makes a gas-tight connection by a slight turn to the right; a short piece of rubber hose is then used to make another gas-tight connection. Then four cocks are opened in a specified order, and the gasoline flows in, while air under pressure, charged with gas, flows out into the can. To obviate the danger of overcharging the carburetters (which is stated to be slight) the central cocks are both closed, and the central connection disconnected, leaving on the hose. Then a cock is opened to let out the air pressure of 3 lbs. per sq. in. from the can, and consequently, there will be a rush of charged air from the carburetter into the can, which carries with it any unabsorbed fluid gasoline. The carburetters once charged burn 120 to 125 hours. They are enclosed on the outside by a double kalameined iron mantle, within which the heated air from the car circulates. About five minutes is needed for charging.

From this description it will be seen that there is no gas carried through pipes, in the ordinary sense. The carburetter is outside the car, and the whole burning apparatus, likewise, is practically cut off from the atmosphere of the car. The only dangers come in the transportation and storage of the gasoline; the charging of the charging cans; the chances of leakage and breakage in filling; of possible leakage of gasoline from imperfect carburetters; of explosion from improper lighting of the lamp, and of fires started or fed from ruptured carburetters, in case of collisions, derailments, or other train accidents.

Are these dangers real or imaginary? If they are imaginary during the experimental stage, when small quantities and few cars are handled by skilled men, constantly on their guard, to what extent do they become real when the system becomes general and is manipulated by the ordinary run of employés, who from long immunity may be ignorant and contemptuous of possible dangers? Two gallons per carburetter per fortnight means for the 30,000 or so passenger train cars in the United States the handling of 180,000 galls. weekly, or nearly 1,000 bbls. daily, both in bulkand in 2-gall. charging cans by perhaps 2,000 different men. To what extent if at all, would this increase the risk of fire accidents?

To apply precisely the same system to house lighting would be impossible, for lack of a store of compressed air. The present system, which is in extensive use, and on the whole a tolerably safe one, although many distressing casualties have followed from it, places the carburetter and other plant exterior to the house supplied. What would be the general effect on safety if there were a separate absorbing carburetter for each light, heated from the gases of the light, and placed, say just outside the window, with the light just inside? And last, but not least, to what extent is the additional danger of rupture in case of train accidents, which does not exist in ordinary house lighting, entitled to weight?

These are questions that everyone must answer for himself, and according to his answer will be his conclusion. We have endeavored to state fully and fairly the grounds on which the answer must be based. That the particular system in question is as safe as a gasoline system can be made, we believe. That it has been ingeniously and thoughtfully worked out, and is a great improvement on past systems, we are quite ready to admit. That it is entirely safe under ordinary conditions with ordinary care, we are not prepared to deny. Whether ordinary conditions always exist, whether ordinary care can always be had, are the real points to be discussed, and in regard to them it seems to us there can be no question. If the only alternative were gasoline or tallow dips, or gasoline and the old car candles, we should be inclined to say, Use the gasoline; just as we should say, if the only alternative were stoves in each car or going cold, Use the stoves, and brave their dangers as the lesser evil. But such is not the alternative in either case; and we have an abiding conviction that the Pennsylvania or any other company which, in the face of modern progress in other directions, reverts to this most treacherous of all illuminants for lighting its cars, will yet have bitter reason to regret taking a step backward for which there is no real necessity or excuse other than the possible saving of a few beggarly cents a day per car, which may be more than lost indirectly in the expense of the extra precautions required for handling such a fluid. It is for these reasons, and from a sense of public duty, that we have written and with a real and keen regret that we may appear to attack private interests to which, as such, we wish only good. We pass over all technical difficulties, such as that of charging the air with just enough and not too much gasoline under all conditions; we assume that these and others which have proved insuperable in the past, have been overcome; we take our stand on the broad ground that the filling and carrying of two-gallon tanks of gasoline, 10 ft. apart, along the roof of every passenger train, is a serious addition to the perils of travel by rail, which is wholly unnecessary, and therefore wholly indefensible.

* Air at different temperatures will carry about the following percentages of the vapor of gasoline:

14° Fahr.	5.7	60° Fahr.	22.0
32° "	10.7	68° "	27.0
50° "	17.5	104° "	39.0

The Memphis Sewerage System.

In our correspondence columns we print a letter from Col. GEORGE E. WARING, Jr., which was called out by our late editorial on the Memphis system of sewerage. We then made the point that the real issue was whether or not Col. WARING had improved upon methods previously devised and actually used. But again our correspondent declines to note the features in his system that might be called novel, and dwells upon certain other features which are certainly not novel, and cannot therefore be claimed as his improvements. These are (1), the complete exclusion of rainwater, and (2), the automatic flushing of all the dead-ends in the system.

Now as to Claim 1: As far back as 1847, JOHN PHILLIPS, the then city surveyor of London, first proposed the separate system. After pointing out the evils of the old sewers, he says that a remedy "is to be obtained by altogether excluding the rainfall from the sewerage channels."

And again:

> A complete and effectual remedy would be accomplished · · · in my opinion, by removing the sewage by itself in a system of branch and main pipes, which should be separate and distinct from the drains which remove the rainfall and subsoil waters as the water supply pipes are from the gas pipes. The pipes from the sinks should be 2 ins. diameter and those from the water closets, 4 ins. diameter. This size from ordinary houses should be continued into the main pipes outside the houses with proper curves at all junctions and changes of direction. The sizes of the main pipes should be regulated according to the fall and the maximum quantity of sewage to be received by them, the minimum size being 5 or 6 ins. The main pipes should communicate with each other until they deliver the sewage into one or more outfall pipes leading into the country.

With this ancient history before us, it is difficult to conceive how Col. WARING can claim as his individual practice and property the complete exclusion of rainwater from sewage channels.

The entire exclusion, however, was generally found to be impracticable on account of the necessity for a second system of house-pipes to provide for water coming from the house-tops and back yards, which must otherwise flow over the surface to the streets. Mr. EDWARD MONSON, a London surveyor, in his pamphlet of 1875, advocating the separate system, says: "The mistake hitherto made has been to keep sewage free from rainfall, a thing which is impossible." But he limits the

admission of rainwater—as was done in Gottenham since 1852—to whatever quantity requires removal from the rear of dwellings, and he considers this quantity even beneficial for flushing both house drains and main sewers. As this same practice seems to be decidedly gaining ground in the United States, the method advised by Col. WARING is a step backward. Sir ROBERT RAWLINSON in his "Suggestions" also gives a certain minimum capacity in the remark, "if even every drop of roof and surface water can be excluded."

Now as to Claim 2, regarding flush tanks at all dead ends of systems: Mr. J. BAILEY DENTON, C. E., in his published lectures on sanitary engineering, delivered in 1876, advises as follows on this subject:

At the head of all sewers some means should be provided of admitting water . . . . for use in flushing during dry weather.

Among other methods he says this can be done

by a sufficiently frequent and automatic discharge of the liquid refuse of sinks, which may be effected by Field's flush tank or some such contrivance. By the use of tanks of this character, the rainwater from the roof may also be turned to account for flushing. And as it is only when the tank becomes full that its contents are discharged, the slightest showers are made to contribute.

With this evidence before them, we must leave our readers to judge whether Col. WARING can justly claim—as he does claim—that both of these features of rainwater exclusion and automatic flushing "are undeniably original with me." As Col. WARING also says that these two features make up the "important difference between English practice and his own designs," the "difference" becomes very infinitesimal indeed.

We did intimate that some of "the forty or fifty towns in the United States" seemed to have reason to regret that the WARING system had been applied to the removal of their sewage, and we did so on the authority of our exchanges and recent discussions. In the first place, the letters called out from engineers by Col. WARING'S list of towns would tend to show that, strictly speaking, his system was used in much less than forty towns. And Mr. HARTFORD'S report on the Memphis sewerage system, the most important example of Col. WARING'S practice, is certainly very far from expressing satisfaction with that practice. The case of Omaha, Neb., in 1882, and the recent very lively expressions of opinion at Stamford, Conn., also condemn the working of the system in those places. The trunk sewer in Buffalo is likewise furnishing plenty of food for indignant comment in the press of that city. This sewer was designed and built by Col. WARING in strict accordance with his favorite theory of reducing the area of drainage channels, and for the alleged purpose of very materially reducing the cost of the sewer. This was done in direct opposition to the practice advocated by such eminent and experienced engineers as E. S. CHESBROUGH, MOSES LANE, W. J. MCALPINE, J. W. ADAMS, and Gen. WM. SOOY SMITH, who recommended a sewer of nearly double the area adopted by Col. WARING. The outcome has been that the present sewer cost almost as much as the estimated price of the proposed larger sewer, and the Mayor of Buffalo now states, through his secretary, that it is an engineering failure, so far as the object for which it was built is concerned; in other words, it is too small to do the work imposed upon it. With this material before us, Col. WARING can hardly blame us for expressions of doubt as to the general public approval of the methods he so strongly advocates.

National Regulation of Railway Safety Appliances.

A copy of the subjoined circular, dated May 17, has been addressed by the Interstate Commerce Commission to all State Railroad Commissioners, and to some others who are supposed to have given especial attention to the matters involved:

MAY 17, 1889.

DEAR SIR:—The large number of accidents to employés and passengers occurring on the railroads of this country, and the public belief that a great part of these might be avoided by the use of proper appliances, have led many States to make the mechanical features of railroad working the subject of statutory regulation. It is well known, however, that in respect to some at least of these features the conditions are such that regulation, if attempted, can neither secure adequate benefit to the public nor be just to the railroads themselves unless it be uniform over the whole country.

In view of this fact and of the request of the Railroad Commissioners of the country, as embodied in the resolution adopted at their recent convention, the Interstate Commerce Commission desires to call out as full information and discussion as possible upon the question of federal regulation of safety appliances on railroads. The following matters seem to be of especial importance, but it is not intended to restrict the discussion to them:

1. The history in each State of safety-appliance legislation. How far such legislation has been enforced. What have been the means used to enforce it. What obstacles have been met with. What the general effect has been.

2. What is the present condition regarding automatic couplers. What prospect there is of a uniform and safe coupler coming into use. What progress the standard coupler, adopted by the Master Car Builders' Association, is making, and what is the attitude of railroads toward it.

3. What progress there is in the use of train brakes on freight cars. Whether such progress is satisfactory, viewed as a means of greater safety to train men. To what extent freight trains are run without the necessity of brakemen traversing the tops of cars.

4. What is being done to introduce safer methods of heating and lighting passenger cars.

5. What is the state of affairs respecting other safety devices.

6. Whether legislation looking to federal regulation of these matters or any of them is desirable, and what the reasons are for and against such regulation.

7. What such federal legislation, if any be desirable, should attempt to accomplish in regard to couplers; in regard to train brakes; in regard to car heating and lighting; in regard to other matters. What its provisions should be upon each of these points.

8. If federal legislation be expedient, what special administrative agencies, if any, should be provided to carry it out. Whether federal inspection should be attempted, and to what extent and how. Whether a Board should be created after the analogy of the Steamboat Inspection Service. If so, how such a Board should be constituted in regard to the number and character of its members; what its powers and duties should be; what its connection with other branches of administration.

The Commission believe that justice to railroad employés and to all others concerned requires that this matter receive thorough consideration, and trusts that you will be able to give it immediate and careful attention.

We have briefly commented on this circular editorially.

Cost of Track-Laying.

At the fourth annual meeting of the Illinois Society of Engineers and Surveyors, at Bloomington, Ill., the subject of track-laying and its cost was informally discussed. Mr. HANSEL gave the cost as $350 per mile for laying and nearly one dollar per lineal foot for total cost if iron and ties were included. Mr. MORSE said that the C. B. & Q. R. R. Co. let the track-laying on one of its branches in 1888 for $300 per mile; and Mr. CANTINE said that in Western Kansas the cost of laying new track was $500 per mile, including maintenance of train crews.

Mr. A. R. TALBOT presented for Mr. MUNSON, track engineer of the Atchison, Topeka & Santa Fé R. R., a detailed statement of the distribution of force and the cost of laying track at the rate of two miles per day on the road named. Ties were hauled by team and the track laid in the ordinary way. On the Larned branch 15 miles were laid in 7 days, but under the favorable circumstances of light grades, light work, road-bed in first-class condition and light earth for ballast. On the Arkansas City extension the main track laid in a month cost $292 per mile. Mr. MUNSON thought that, under ordinary conditions, track could be laid and surfaced for less than $350 per mile.

The data given by Mr. MUNSON are as follows:

COST OF TRACK LAYING.

Force for laying 2 miles per day:

No. of Men.	Occupation.	Rate per Day.	Amt.
15	Running iron car	$1.75	$26.25
2	Unloading iron	1.75	3.50
24	Spiking	1.75	42.00
8	Strapping	1.75	14.00
5	Spacing ties and "squaring" joints	1.75	8.75
4	Lining track	1.75	7.00
7	Setting "joint and center "ties	1.75	12.25
2	Carrying gauges	1.75	3.50
2	Distributing spikes	1.75	3.50
1	Caring for tools	1.75	1.75
42	Bedding ties	1.40	58.80
12	"Nippers"	1.40	16.80
18	Handling ties	1.40	25.20
2	Stretching tie line	1.40	2.80
4	Carrying water	1.40	5.60
1	General foreman	3.33	3.33
1	Foreman iron car	2.50	2.50
1	Foreman tie-bedding	2.50	2.50
1	Foreman handling ties	2.50	2.50
1	Foreman track lining	2.50	2.50
1	Foreman spiking gang	2.00	2.00
10	Extra men	1.40	14.00
	22 teams hauling ties	3.50	77.00
	1 team hauling iron car	3.50	3.50
164	Cost for labor only, of *laying* 2 miles of track		$341.53

Force for surfacing 2 miles of track per day:

No. of Men	Occupation.	Rate per Day.	Amt.
1	Foreman	$2.50	$2.50
1	Foreman raising track	2.00	2.00
2	"Back bolters"	1.75	3.50
80	Shovelers	1.40	112.20
84			$120.00

SUMMARY.

Cost, for labor only, of surfacing 2 miles of track	$120.00
Cost, for labor only, of laying 2 miles of track	341.53
Sup't of track laying	5.00
Timekeeper	3.00
Train and engine crews	15.04
Engineering	10.97
	$495.54
Total cost for labor only of laying and surfacing 2 miles of track	$495.54
Cost per mile	$247.77

NOTE:—The above does not include the cost of supplying and distributing ballast by train.

Pig Iron Competition.

The competition of the Southern iron works, with their wonderful natural advantages, is being severely felt in Pennsylvania and Ohio. One of these Southern works, we have been told on good authority, although we cannot vouch for the fact, is putting its ore on the cars at 45 cts. per ton. As a consequence, one of the leading iron corporations of Pennsylvania, the Thomas Company, has lately reduced the price of its product to $15.50 per ton. This is the opening of what is expected to prove to be an important and probably a long continuing war. It has even been asserted that the loss inflicted last year on Northern ironmasters by the lowering of price consequent on the cheaper production of iron in the Southern States was so great that it would have enabled the Northern works to buy out and destroy every iron works in the South.

The Atlanta *Constitution* says of the action of the Thomas Company:

The low price of Southern iron has placed the Pennsylvania ironmasters on the defensive, and they have simply reduced prices in order to place their product on a footing with Southern iron. Recently the railroads of this section, looking to their own interests, have arranged to place the output of Southern furnaces on a footing with that of Northern furnaces, so far as freight rates are concerned, and it is this last feather that has caused the Pennsylvania camel to have the backache. Southern iron is now selling at $14.50, and at this rate a very large profit can be made. The understanding is that Pennsylvania iron cannot be drawn for less than $13 a ton, but Southern iron can be produced for $9, so that if the Pennsylvanians have organized to drive the Southerners out of the market they will discover their m stake a little later in the season. The Thomas Company's cut in the price of iron is made to protect that company's interest, and it is levelled at the Southern producers. But the real effect of it will be to drive out of business a great many of the smaller furnaces in the Lehigh Valley, which are poorly equipped for competition of any sort. The Southern furnaces have all the modern improvements, and although Mr. B. W. CLARK, president of the Thomas Company, is inclined to sneer at the extent of their resources, it will be found when the fight is fully on that they have capital enough to protect themselves. As a matter of fact, they need no capital for this particular business. They have equipments that are superior to a majority of those in Pennsylvania, and they can sell iron at a profit at prices that will drive every furnace in Pennsylvania to the wall. This is the situa-

tion. The issue is joined, so to speak; and while the fight may result in a pool or trust, we should like to see the competition carried to its legitimate result, which would mean the supremacy of Southern iron in Northern markets.

We agree with the *Constitution*, and if the claim advanced by it be true, hope there will be no pool or trust to interfere with natural competition in our own country.

Scotch pig now ranges in price from $10.40 to $13.20, freight from Glasgow to New York being about 60 cts., and from Liverpool, $2.40. Cleveland pig is worth $9.40 and Bessemer pig about $12. The tariff on pig iron is now 3 cts. per lb., or $6.72 per ton.

THE BENEVOLENT FUND of the Institution of Civil Engineers amounts to over $140,000, according to the last report, and the grants of assistance last year were nearly $16,000. Something over $5,000 per year is derived from annual subscriptions, and the rest from income on investments. Lord ARMSTRONG offered to contribute £5,000 to the fund if a like amount was elsewhere raised, and in response £3,338 was subscribed with further annual subscriptions of £523, which capitalized at 17 years, represents £8,891, or £12,229 in addition to Lord ARMSTRONG'S £5,000. Thus the magnificent addition of £13,891, or about $69,000, has been made to the fund in one year. Out of 4,706 members, 1,142 have contributed more or less to the fund, which is most admirably managed to save the self-respect of beneficiaries by avoiding publicity while carefully guarding against abuse. Not even the total number of beneficiaries is publicly reported. The fund is another evidence of the admirable management of the Institution.

THE PRODUCTION OF PIG-IRON IN THE GERMAN EMPIRE (including Luxembourg) for the month of February, 1889, says *Glasers Annalen*, was 334,912 tons, viz.: 155,060 tons forge-pig, and 33,691 tons Bessemer-pig, 105,630 tons Thomas-pig, and 40,531 tons foundry-pig. The production in February, 1888, amounted to 332,841 tons. From Jan. 1 to Feb. 28, 1889, 702,023 tons were produced against 685,803 in the same period of the preceding year.

PERSONAL.

Mr. W. S. LARENDON has been appointed Superintendent of the new Union Street Ry. Co., at Atlanta, Ga.

Mr. J. W. WHARTON has been appointed Street Commissioner at Rogers Park, Ill.

Mr. JOHN CARNEY has been appointed Superintendent of Water-Works at Evanston, Ill.

Mr. AUSTIN CORBIN has been elected President of the Chicago & Ohio Ry.

Mr. KENNETH ALLEN, C. E., of Kansas City, Mo., has been appointed Superintendent of Construction for that city.

Mr. DONALD MCDONALD has been appointed Assistant General Manager of the Chesapeake & Ohio, with headquarters at Cincinnati, O.

Mr. C. T. ARNBERG, of the Rensselaer Iron Works, of Troy, N. Y., has been appointed Superintendent of the Wheeling Steel Company's plant at Benwood, W. Va., vice Mr. JOHN E. FRY resigned.

Mr. M. B. CUTTER has been appointed Superintendent of the Chesapeake & Ohio Ry. division between Richmond and Newport News.

Mr. HERMAN W. HORNE, late of the city engineer's office at Manchester, N. H., has been elected City Engineer of Whatcom, W. T.

Mr. HORACE G. JACOBS has been appointed Superintendent of Construction of the Government buildings at Los Angeles, Cal.

Mr. J. S. PATTERSON, Superintendent of Motive Power of the C., I., St. L. & C. road, has tendered his resignation, to take effect June 1.

Mr. H. N. TURNER, of St. Johnsbury, Vt., has been elected a director of the Boston, Concord & Montreal.

Mr. EDWARD BATES DORSEY, M. Am. Soc. C. E., is now in South Africa on railway business in the interest of English capitalists.

Mr. COLGATE HOYT has been elected Vice-President of the Oregon Transcontinental Company, vice Mr. BRAYTON IVES resigned.

Mr. T. H. MONKS has been appointed General Manager of the West End Street Railway Co., Boston, Mass., vice Mr. LONGSTREET, resigned.

Mr. J. T. R. MCKAY has resigned his position as chairman of the Freight Committee of the Central Traffic Association on account of ill health, and is making an extended tour through Europe.

Mr. WM. S. MELLEN, General Manager of the Wisconsin Central lines, will become General Manager of the Northern Pacific system on July 1.

Mr. GEORGE RODGEMEN, Assistant Superintendent of the new Chester Water Co., Chester, Pa., has resigned, and will go into business. He has been connected with the works for 15 or 20 years.

Mr. THOMAS WELSH has been made Master Mechanic of the Henderson division of the Louisville & Nashville, at Henderson, and Mr. W. W. PIKE, of the shops at Decatur, Ala.

Col. SAMUEL S. FOWLER, of Lancaster, Pa., the projector of the Reading & Chesapeake Railroad, of which he was president, died suddenly, May 15, at Lancaster.

Mr. J. T. ODELL has been appointed General Manager of the entire Baltimore & Ohio system, and Mr. W. W. PEABODY has been appointed General Superintendent of the lines west of the Ohio river.

Mr. JOSEPH H. MORRISON has been appointed Resident Engineer of the western division of the Wabash Western, with headquarters at Kansas City, Mo. He succeeds Mr. C. H. TALMADGE resigned.

Mr. FREDERICK W. FOOTE, a director of the Louisville & Nashville and Nashville & Chattanooga railway companies, and of the United States Rolling Stock Co., died at Far Rockaway, N. Y., May 13.

Mr. STEHMAN FORNEY, of California, is said to be a candidate for Chief of the Coast and Geodetic Survey. He has been in the service 24 years, of which 21 years have been spent on the Pacific Coast. The position is worth $6,000 per annum.

Col. D. S. WALTON, City Engineer of Portsmouth, Va., died May 9. During the war Col. WALTON was in the engineer corps of the Confederate army, and after the war was engaged in New Orleans and on the Isthmus of Panama for the Government. For a number of years he was engaged on the Erie canal and important water lines in Canada. He was about 70 years old.

President HARRISON has made the following appointments: JOHN F. PLUMMER, of New York City. GEORGE E. LEIGHTON, of St. Louis; JESSE SPAULDING, of Chicago; and RUFUS B. BULLOCK, of Atlanta, Ga., to be Government directors of the Union Pacific Railway Company.

Mr. MALCOLM A. MCDONALD, General Manager of the Cairo & Vincennes road, has accepted the position of General Manager of the Pittsburg & Western, at a salary of $12,000 per year. The same syndicate controls the Pittsburg & Western that placed Mr. MCDONALD in control of the Champaign & Havana, and afterward of the Cairo, Vincennes & Chicago.

Mr. W. H. NEWMAN, Third Vice-President of the Missouri Pacific, has resigned, and will sever his connection with the system June 1. Chairman J. S. LEEDS of the Transcontinental Traffic Association, has resigned his position and accepts the place of Freight Traffic Manager of the Missouri Pacific. The office of Third Vice-President of the Missouri Pacific has been abolished.

Mr. ROBERT B. STANTON, M. Am. Soc. C. Eng., of Denver, Col., late Div. Engineer of the Union Pacific Railway, has been appointed Chief Engineer of the Denver, Colorado Cañon & Pacific Railway, a startling new project which seems to have considerable backing, and which was commented on more fully in our issue of April 6. The latest news about the project is given elsewhere.

Mr. WILLIAM THOW, Locomotive Engineer of the South Australian Government Railways, has accepted a similar position on the New South Wales Government Railways, and succeeds MR. THOMAS MIDELTON, who retires. The engines and rolling stock are said to be in an unsatisfactory condition, and extensive improvements are contemplated.

Mr. HENRY A. BENTLEY, C. E., of Newport, R. I., was drowned in Long Island Sound, May 17. Mr. BENTLEY was about 45 years old, and he has been connected with many public improvements in Newport. He furnished the plans for the sewerage system of the city, and for many years was Commissioner of Streets.

Mr. WM. H. BRYAN, of St. Louis, Mo., for many years connected with the Pond Engineering Co., and whose specialty was the department of steam plants for electrical service, has become connected with the Heisler Electric Light Co., with offices at 809 to 817 So. Seventh St., St. Louis. He will be glad to hear from any one who may be investigating the question of incandescent electric lighting.

Major A. B. ROGERS died at Waterville, Minn., on May 4. Major ROGERS is credited with the discovery of the Kicking Horse Pass, through which the Canadian Pacific Railway crosses the Rocky mountain range. He located the whole line west of Manitoba, says the St. Paul *Pioneer Press*, and was engineer in charge of the construction of this part of the road, his services in this connection being recognized in the form of a magnificent watch, presented to him by the directors of the road. He had previous experience as an engineer on the Northern Pacific and other Western roads, having commenced his engineering life on the Minnesota Central Railway about 1858.

Mr. BRIAN DOUGLAS MCCONNELL, who succeeds the late LOUIS LESAGE as Superintendent of the Water Department of Montreal, was born at Gaspé, P. Q., and commenced engineering as a student in the office of Mr. T. C. KEEFER, C. E. When he had served his time he was engaged in the preliminary survey for the Hamilton water-works. Subsequently he acted as Assistant Engineer for the Montreal Harbor Commissioners, being engaged on river work between Montreal and Quebec. He then helped to carry out the enlargement of the harbor at Saginaw Bay, Mich. He was in the service of the Government during the survey, location, and construction of the Intercolonial Railway, which finished, he became Resident Engineer of the Wellington, Gray & Bruce Railway. He was then engaged on the Canadian Pacific Railway on the exploration surveys, and after that located the North Shore Railway, between Three Rivers and Berthier. He subsequently again engaged upon the preliminary surveys of the Canadian Pacific Railway, and left there 15 years ago to become Resident Engineer of the new aqueduct and of the corporation water-works; 11 years ago he was appointed to the position of Assistant Superintendent of the Water Department.

Skew-Portals—Correction.

Mr. M. G. LIPPERT sends us the following correction, calling attention to what was probably a transposition of two types:

Referring to the article in No. 20 of your paper (May 18) giving Mr. A. J. LESCHORN'S account of my method of calculating skew-portals for bridges, I wish to call attention to an error, which gives the date when the method was first used by me as 1887 while it really was 1878.

PUBLICATIONS RECEIVED.

—*The Railways of England.* By W. M. ACWORTH London, John Murray. 8vo, pp. 437. 56 plates. No maps. $——

An interesting popular account of the rise and present status of 11 great railway lines, not at all strong on the technical side, but readable and full of odd facts about railways.

—*Abstract of Acts of Parliament Relating to Water Undertakings*, 1879 to 1888. By EDWARD KYNASTON BURSTAL. 2d edition. With rules and regulations applicable to the conduct and management of such undertakings. London, Henry Froude. 4s. 6d. 12mo., pp. 84, chiefly tables.

This little volume gives water-works regulations, financial statistics, water rates, etc., etc., for from 100 to 250 water-works. The legal regulations are much more detailed and stringent in England than here, and vary more with special cases.

—*Sixth Annual Report of the Board of Railroad Commissioners of the State of New York.*—For the year ending Sept. 30, 1888. WM. E. ROGERS, ISAAC V. BAKER Jr., MICHAEL RICKARD, Commissioners. 2 vols. 9¼ x 6 ins, 1,519 pp, cloth bound, with map

CORRESPONDENCE.

Rise and Fall.

NORTHFIELD, Vt., May 18, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

I have accepted the definition of "rise and fall" as: "Add up all the ascents and descents from the profile going in one direction and divide by two." If this be correct, the note at the bottom of p. 259 of WELLINGTON'S "Economic Theory of the Location of Railways" evidently needs a little extension, as the definition on p. 374 does not cover the subject. The note to Table 101 on p. 259 reads: "Thus, if a road rose 500 ft. and fell 200 ft. in 100 miles, it would be given as 'Rise per Mile, 3.0,' 'Rise and Fall, 2.0.' The first quantity is an unavoidable necessity, due to difference of level." It seems by this note that feet of rise and fall is taken as the ascents + descents from the uniform grade line connecting the two points. I should have taken the total number of feet of rise and fall, from what I have been taught and always understood, to be $\frac{500 + 200}{2} = 350$ ft. instead of 200 ft., as you have found it. Am I right or wrong? The tables, under the heading of "Rise and Fall per Mile," seem to indicate the latter. B.

[Our correspondent is perfectly correct in his first definition. Table 101, on p. 259, is computed from the census statistics, and had for its purpose only to give as clear an idea as possible of the general char-

acteristics of the lines tabulated, for which end it is clearly necessary to distinguish between *enforced* rise and fall, *i. e.*, that due to difference of level of the termini, and rise and fall proper, *i. e.*, that introduced merely to save work or curvature by following the irregularities of the surface. The different classes of rise and fall differ so greatly from each other in cost and disadvantages that it is rarely necessary or useful to sum up the total feet of rise and fall on a line, and a comparison of the two alternate lines by such a total may be, and probably will be, deceptive and misleading. But if such a comparison is to be made, our correspondent gives the correct rule for making it, as would seem to necessarily follow from the rule referred to on p. 374: "A foot of rise and fall is ordinarily considered as one foot of ascent with its corresponding foot of descent," etc. An extension of the rule to cover explicitly totalings of a whole line was purposely omitted, in the belief that it was never really desirable to so total a line.—ED. ENG. NEWS.]

The Frost Dry Carburetter System of Lighting Cars.

PHILADELPHIA, Pa., May 15, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Although the name of our company is not mentioned in the article appearing in your issue of May 11, 1889, pages 430 and 431, we feel it our duty to say to you that the Pennsylvania Railroad Company is not "experimenting" with a system of car lighting by gasoline, but that they have long ago passed that stage (after two years experimentation) and have adopted our system of car lighting, (the Frost dry carburetter) as their standard, and are equipping their entire system as fast as we can furnish the material. The official directions for handling our system issued by them do greatly exaggerate the necessary precautions for the same, and we think they are now aware of that fact as well as we. Our system is absolutely safe in every sense, and only requires careful handling by those who charge the carburetters, just as other systems of lighting require care,—kerosene lighting, in filling the lamps; compressed coal gas lighting, in charging the cylinders; electrical lighting, in proper insulation. Our system is not dangerous, and its safety lies in its pure simplicity.

The few extracts which you have taken from the Pennsylvania Railroad Company's official instructions would require too long explanation to be put in the shape of a letter. For your better information about our system of car lighting, we send herewith a proof of our book, as it is now going to press, and we cordially invite you to inspect our system in course of construction at our factory. Our General Manager (Mr. FROST) will be pleased to meet your representative, and explain the system in its entirety, at any time that you may see fit to appoint.

We are free, open, and above-board, and are not introducing a dangerous system of car lighting, by any means. We believe that if you had seen our system in course of manufacture, and understood the principles of the same, you would never have written the article. Our system is like everything else that is new, it must be understood before it is appreciated; and as soon as our book is printed and distributed, we feel that ours will be the universal system of car lighting. You state: "If there is another side to this question, we shall be glad to hear and present it." We take you at your word.

Yours very truly,

THE RAILWAY LIGHTING & HEATING CO.

[We give space to this communication with pleasure, and discuss it elsewhere.—ED. ENG. NEWS.]

A Monument to Prof. Emil Winkler.

Mass. Institute of Technology, Dept. of C. E.,
BOSTON, May 13, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

On August 27, occurred in Berlin the death of Prof. EMIL WINKLER, Professor of Bridge Engineering in the Royal Polytechnic School. Prof. WINKLER was well known to many engineers in this country, both personally and by his writings, which covered a wide field and treated very exhaustively of certain subjects. In Germany he was recognized as a leading authority on bridges. To those who knew him personally he endeared himself by his kind but unassuming spirit and his staunch and steadfast friendship, and he commanded their admiration by his devotion to his profession, his untiring energy and perseverance, the range and thoroughness of his attainments and his almost limitless capacity for work. He had for many years, however, overtaxed his strength without knowing it, and was finally brought, at the age of 54, to an untimely end, just when his experience and knowledge were of the greatest value.

A movement is now on foot to erect a bust of Prof. WINKLER as a memorial in the Polytechnic School, with which he was so long connected. I beg to call the attention of your readers to the opportunity which is now before them to contribute toward a memorial of this distinguished man, believing that those who have known him personally or through his writings, and who have experienced the enthusiasm which he infused into all who knew him, will only need a knowledge of their opportunity in order to take advantage of it.

Contributions, however small, will be thankfully received, and it will undoubtedly be a gratification to those who have the matter in charge to be thus assured of Prof WINKLER'S standing on this side of the Atlantic.

Contributions may be sent to Ernst & Korn, Wilhelmstrasse, 90 Berlin, or to Herr Rechnungsrath Hoffmeister, Königl Tech. Schule, Berlin-Charlottenburg. If preferred, the undersigned would be happy to remit any amounts which are sent to him.

GEO. F. SWAIN.

[This is an opportunity to do honor to the memory of a man to whom many engineers are indebted, that we would be glad to see embraced. Engineers, as a class, are too often forgotten after their busy race is run, and while we know of more than one American whose memory likewise demands a fitting memorial of services rendered, the profession of engineering knows no country or nation, and any contribution to the memorial proposed for this famous German brother would be a graceful and appropriate act.—ED. ENG. NEWS.]

Drifting Tests.

NEW YORK, May 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Some years ago, the drifting test as applied by the master mechanic of one of our railways to his boiler steel was published. It seemed such a convenient test that I have used it at various times since.

About two years ago the question was referred to me to decide whether a very large quantity of steel plate, which had been punched, could be safely used without reaming or annealing, either method meaning a large additional expenditure of time and money. The plates were ⅝-in. thick, and were punched with 1¼-in. holes.

Plates were selected at random and tested by the drift test. Under this brutal test, the holes were elongated from 1¼ ins. to 2¼ ins., without crushing the material either inside of the holes or on the exterior *sheared* edges. These tests satisfied me that reaming or annealing would not better this material for the intended duty. The steel was a very soft, homogeneous material. To determine whether other steels would give as good results, I had tests made on a much harder steel (62,000 to 68,000 tensile strength). One-half of the test pieces, after punching, were reamed and the other half left as they came from the punch. The tests were also duplicated in iron. The following table gives a summary of the results.

Percentage of Increase in Size of Holes, before the Material shows evidence of cracking.

	⅝-in. *steel plates.*		⅝-in. *iron plates.*	
	Holes punched.	*Holes punched and reamed.*	*Punched.*	*Punched and reamed.*
Min. result	54%	93%	54%	46%
Max. "	123 "	160 "	54 "	46 "
Ave. "	97 "	106 "	54 "	46 "
	5 x 3½ x ⅝ *steel angles*		5 x 3½ x ⅝ *iron angles*	
Min. result	92%	33%	36%	24%
Max. "	115 "	176 "	36 "	24 "
Ave. "	100 "	73 "	36 "	24 "

In the above the external edges of the angles and plates were mill-rolled.

Another series of tests was made with holes punched within 2 diameters of edges that were sheared.

	Steel plates	*Steel angles*	*Iron plates*	*Iron angles*
Min. result	11½%	10.8%	15%	14 %
Max. "	14 "	12 "	17 "	15 "
Ave. "	12 "	11.4 "	16 "	14½ "

Another series of tests was made by a different inspector on a different make of steel, but of about the same tensile strength, with very similar results.

In my general specifications, published June, 1888, I introduced the following clause:

Soft Steel.—113. Soft steel (§ 131) may be used under the same conditions as wrought-iron for all *riveted* work. Provided that,

114. Any rivet-hole, punched as in ordinary practice (§§ 42 and 43), will stand drifting to a diameter 25 per cent. greater than the original hole without cracking, either in the periphery of the hole or on the external edges of the piece, whether they be sheared or rolled.

At my recommendation Mr. CROES introduced it into the specifications for the girder work of the Suburban Rapid Transit Co. lines.

I requested Messrs. Hunt & Clapp and Messrs. Ferris & Co. to extend the above tests to other steels and other sizes of material, making comparison with similar forms of iron and with holes punched and reamed.

I also endeavored to get the bridge companies interested to make similar tests, to determine whether on mild or soft steel any gain, as far as reliability is concerned, is obtained by reaming punched holes.

Yours truly,

THEODORE COOPER.

The Memphis Sewerage System.

NEWPORT, R. I., May 13.

TO THE EDITOR OF ENGINEERING NEWS:—

I have read with care, and no little gratification, your careful editorial on the Memphis system of sewerage (page 408) and with care the communication from Mr. RUDOLPH HERING, published in the same paper.

I am fully aware that you have already given a good deal of space to this discussion, but as you say that my responses "deal chiefly with side issues, silently passing by the real issues, etc.," I trust that you will allow me to speak as to what you regard as the real issue. That is, whether my system is or is not an improvement over methods previously used.

The Memphis work made the deviations from previous practice to which you refer, but most of these are relatively unimportant. The important differences between it and the Separate System, long practised in England, and described in the works to which you refer, are only these: *a*. The complete exclusion of rain water; and, *b*, the automatic flushing of all of the dead ends of the system. As to the exclusion of roof water, it is practically complete in all of the systems working under my method, the admission of a little roof water here and there being of no consequence, any more than is the small amount of ground water that leaks into the sewers through slight imperfections of material or jointing. The system is constructed to exclude practically all such extraneous water; the amount admitted, in any case of which I have knowledge, is but a small percentage of the safety margin allowed for in calculating sizes.

It seems to me that the "real issue" is confined to the benefits derived from these two modifications, both of which are undeniably original with me. The exclusion of rain water, if it had no other effect, would have the very important one of giving uniformity of quantity and quality to the outflow, making the question of disposal less troublesome and less costly. The periodical flushing,—which the city engineer of Pawtucket regards as the "life of a small pipe system of sewers" prevents the stinking deposits which exist in all systems not so flushed; and delivers all foul matters in the sewage at the outlet before putrefaction, thereby again greatly facilitating proper and inoffensive disposal.

The expression of Mr. HARTFORD'S opinion as to the manner in which sewers should be built is entitled to the respect that is due to the statements of a conscientious man, and is to be measured by the value of his knowledge and experience on the subject. If you will read the closing sentences of his report, and the statement contained in his letter to me of October, 1888, you will, I think, conclude that the stoppages to which you refer are not at all due to the "Memphis system of sewerage" but to the Memphis system of letting sewers take care of themselves under the unguided control of the Memphis plumbers. The same system is in use in forty or fifty other towns in the United States, and the testimony is almost universal, not only that there are no stoppages, but that there are no deposits.

If you will investigate the subject, you will find that my statement that this system of sewerage "substantially unchanged" has been applied to "between forty and fifty towns in the United States" is true, notwithstanding your astonishment at the announcement. You intimate that some of these towns, unless you are misinformed, have had reason to regret that the system has been applied to them. I think you have been misinformed. I have never heard of such a case. If one exists, I should like to know of it.

GEORGE E. WARING, JR.

[We have discussed this letter in another column.—ED. ENG. NEWS.]

Memphis Sewerage.

NEWPORT, R. I., May 13, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

It seemed necessary that I should say, concerning Mr. RUDOLPH HERING'S report of his examination of the Memphis system, that it was shown to be "essentially untrue." Referring to this, Mr. HERING says, in your issue of May 4, that he has looked over that report, and finds that everything he wrote is strictly correct, "ex-

cept one word, which was either a misprint or an error of writing." I say, Stoppages have occurred to a great extent, which made it necessary to build manholes every few hundred feet. Instead of *necessary* I should have said *desirable*. They were continually adding manholes and during my visit expressed the wish to have them at every intersection."

This referred to manholes on lateral sewers. I had built most of the manholes on the main sewers myself.

Mr. BALDWIN'S report, made some months after Mr. HERING'S, says:

The whole number so built on lateral sewers, is: Four on the 8-in. line in the alley south of Adams street, all within a single block less than 700 ft. in length. Two on the 6-in. line in the alley south of Market street, 300 ft. apart, one above and the other below a public school; and 2 on the 8-in. line in Adams street and Lauderdale street, 600 ft. apart, where the sewer is deep, and it was thought best to build [use?] manholes already made for another purpose rather than take the risk of having to dig the sewer up again. The whole number of manholes on all the lateral sewers in the city is eight, and the whole length of sewers on all these lines within easy access of manholes is less than half a mile.* No sewer has yet become stopped by the gradual silting-in of deposits, and no 6-in. line has yet been known to run full of water unless when temporarily obstructed. Even the longest lines usually run only about one-fourth full.

Mr. BALDWIN'S report, accompanied by comments of my own concerning this false statement, has been before the public and before Mr. HERING nearly five years. At this late day, he makes the above very amazing statement. Comment seems unnecessary.

He says that everything else that he wrote is strictly correct. One of his statements was that the roof and yard water turned into the sewers "increase their flow very materially during rains, and has compelled the building of special overflows from the sewers into the creek or bayou in order to relieve them during such rains,—a common custom in England."

Mr. BALDWIN says:

Overflows.— During winter it has been found that a large amount of water is wasted, by leaving taps running to avoid freezing in the pipes. To provide for such waste water, *and for this purpose only*, five overflows were made, three on the east side, and two on the west, discharging into the bayou. These overflows are built above the tops of the main sewers, and only come into use when the mains are overcharged.

Mr. HERING says:

In two cases the city was even compelled to build catch basins along that line to prevent the constant silting up of the sewers from the washing of certain stables.

These "catch basins along the line" are not along the line at all, but on private branch drains, used under peculiar conditions.

Mr. HERING says:

While I consider the automatic flush-tanks excellent contrivances, and have often recommended them, I do not think it is well to rely on them entirely, or to use them everywhere. *English engineers do not altogether depend on them*, and the experience in Memphis, I think, likewise confirms the wisdom of this course. One person was engaged for the exclusive purpose of looking after the 184 tanks, of which he inspected 50 every day, and regularly found several out of order.

Here is a false implication. At the time of this writing, English engineers practically did not depend on flush tanks *at all*. Mr. BALDWIN says:

Flush-Tanks.—These have done good service whenever water can be secured to operate them. The muddy character of the water furnished by the public works sometimes causes the supply pipes to become stopped. It is believed that with clear water no such difficulty would be experienced. The chief duty of the inspector is to clean out the mud so deposited.

Mr. HERING says:

The present successful operation is, in my opinion, not due to any novel features, but rather to *their subsequent abandonment*, and to the careful and intelligent management of the works at the hands of Mr. MERIWETHER, city engineer, etc.

There had been absolutely no abandonment of any feature, save that very early during my own construction of the work, fresh-air inlets were omitted. Mr. BALDWIN says:

I spent nearly a week in patient investigation and inquiry, examined the flush-tanks and the main and lateral sewers at all available points, and questioned everybody connected with the work, or who appeared to know or care about it. *I could by no means find any evidence that the sewerage works had been modified or changed in any essential feature.*

Not one of the above statements or implications of Mr. HERING is "strictly correct."

He asked some workmen why they were laying 8-in. pipe where he supposed I would use 6-in. They replied that 6-in. was not big enough. He drew from this the sage conclusion that 6-in. sewers had been abandoned. In fact, the pipe these men were laying was a house drain to connect with the system of sewerage that was built before 1880, and had nothing whatever to do with my work.

At the time of his examination, there was in full working in Memphis a district containing 85,000 ft. of sewers above the highest overflows on the mains, which had not a single manhole on the laterals, and in which not the slightest change of any kind had been made since the original construction. A strictly correct statement, and a fair report of the examination of the system as a system, would not have been weakened by a reference to this fact.

*The whole length of lateral sewers is more than thirty miles.—G. E. W., JR.

Unnecessary attention is being called to the fact that I attempted to secure profit from my invention by having it patented. The most pertinent comment on this criticism would be the simple question, What of it?

One thing is very clear, a patent is not to be invalidated by scolding about it, nor can patent suits be effectively tried in the columns of a newspaper. This patent is now before the courts and will soon be passed upon. If it is not sustained, that will settle the matter, and it is not worth while to discuss probabilities here. Even such a result would hardly tend to show that it is reprehensible for one who can convince the Patent Office that he has made an original invention to accept the protection that the laws offer him.

The case of Alnwick in England, with a population of 7,000, having an outlet sewer 18 ins. in diameter, with a grade of 1 to 400, is cited as proving a substantial exclusion of rain water. BALDWIN LATHAM gives the average water supply of 120 towns in England as 25 galls. per head. If we assume that Alnwick has a supply of 30 galls. per person per day, the daily total would be 28,000 cu. ft. and the maximum flow through the outlet sewer would be about 30,000 cu. ft. per minute. The discharging capacity of the outlet sewer at Alnwick is over 330 cu. ft. per minute. Mr. RAWLINSON recommends that in the system excluding most of the surface water, but admitting water from roofs, should have a capacity of not less than three times, and better, six times the average daily water supply. The Alnwick outlet sewer has a capacity of about ten times the water supply.

Were rain water excluded to the degree to which it is excluded in Memphis, it would not run full if only 10 ins. in diameter.

I never heard it suggested that sewers built according to Rawlinson's "Suggestions" could be rightly called the Memphis or Waring System. GEO. E. WARING, JR.

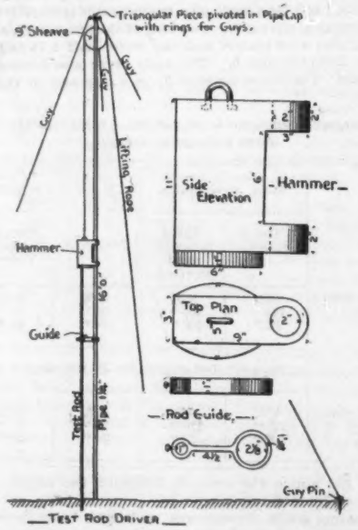
[Was not Mr. BALDWIN, who is quoted in this letter as an authority so frequently, Mr. WARING'S own assistant, sent by him to Memphis to make a report after Mr. HERING had made his? We have so understood it, and if so, Mr. WARING would appear to be almost, in effect, appealing to himself against Mr. HERING.—ED. ENG. NEWS.]

A Test Boring Method.

City Engineer's Office, BUFFALO, N. Y., May 15, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

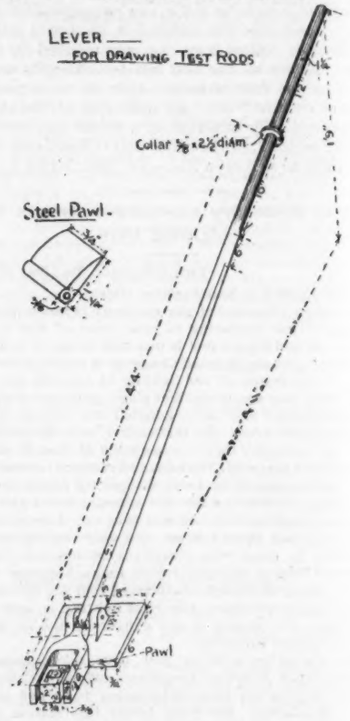
From reading the article in your last issue, May 11, on "Test Borings by Hand Labor," I thought it might be instructive to some of your readers to know the method used in this department of determining depth of rock for constructing sewers, length of piles, etc.



Octagonal steel rods of varying size and lengths are used. The first one driven is ⅞-in. diameter, 5 or 6 ft. long; this is then drawn, and succeeding ones driven in its place, each diminishing in diameter but increasing in length until rock is reached, or sufficient depth for desired work and no rock encountered. The driving is done by sledges; the drawing out by the lever shown herewith, which accomplishes the work easily, no trouble being experienced beyond occasionally breaking a rod, or the little steel pawl in lever head "A". This pawl, as the lever handle is raised, follows down the rod, and in lowering the handle, it (the pawl) clutches the rod, which is thereby raised.

The varying lengths of rods are used, so the driving can be done at starting from a point not higher than a wagon on which the man stands; the diminishing sizes are adopted, so that the subsequent driving and drawing will be lessened by decreased friction.

Three or four years ago, I had a number of deep drivings to make, and made a small driver, as shown by the cut, to reduce the number of rods driven and lesser, the manual labor. By it a rod could be started which was about 2 ft. shorter than the mast. It consists of an iron pipe mast, with 3 guy lines from top to iron test stakes driven into the ground, the hammer of cast-iron sliding on the mast, being operated by a line over sheave in top of the mast. With this driver tests 25 ft. to 30 ft. in depth were made, and apparatus moved



2,000 ft. set up ready to commence again, on an average of one per hour. Of others 12 ft. to 16 ft. in depth. I have before me a record of six tests, total depth 85 ft., on which the party expended 2 hours 18 minutes, averaging 23 minutes per test, the distances apart being only 100 ft. and 200 ft.

I am free to confess the men prefer sledging to using the driver, but not because the latter is more tiresome This method does not disclose the character of soil, for which purpose the Trunk Sewer Engineers used the auger with cross handle, jointed rod, and drawn with lever described. These methods seem simpler and more expeditious than the one you describe, which is cumbersome, and liable to cause vexation of spirit and hard words by breaking of chains, levers, etc.

Yours truly, EDWARD B. GUTHRIE.

An Hydraulic Conundrum.

OBERLIN, Kan., May 13, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Will you be kind enough to answer the following, concerning our water-works?

We have the "tubular" system of wells—32 3-in. wells—connected to a "main center," something as are the spokes of a wagon wheel to the hub. This "main center" is then connected with the pump room by a 12-in. pipe, which is about 60 ft. long. As the pump has only a 7-in. suction, the inner end of the 12-in. pipe is connected with the pump by means of a 12x7 L, to which is attached a 7-in. pipe, being about 4 ft. in length.

Question: Is there not a loss of force in requiring the pump to exhaust the vacuum of the 12-in. pipe? Is it not really a disadvantage to the pump that the suction main should be any larger than the suction of the pump? This has given rise to so much discussion that I appeal to the highest authority I know of, for solution. Yohrs truly,

GEO. W. KEYS.

[There is no loss of force; on the contrary, there is a distinct advantage from the use of the 12-in. pipe. No doubt it takes a few more strokes of the pump to fill all the pipes before water begins to be delivered, but that is not the question. The water

is gathered in 32 3-in. pipes, having a total sectional area of 226 sq. ins.; it flows thence into a 12-in. pipe with a sectional area of 113 sq. ins., or just half as much; and thence into a 7-in. pipe of 38 sq. ins., or one-third as much as the 12-in. Thus the velocity of the water gradually increases from the wells to the pump, and until the water enters the 7-in. pipe there is very little friction, and no great velocity in the water. Were a long 7-in. pipe substituted for the 12-in., there would certainly be some decrease in the delivery, owing to a very considerable increase in skin friction.—ED. ENG. NEWS.]

SOCIETY PROCEEDINGS.

Engineers' Club of St. Louis.—The regular meeting was held May 15, President MEIER in the chair, 43 members and 6 visitors present.

President MEIER read a memoir of the late Col. HENRY C. MOORE, an ex-president of the club. The paper covered the principal events in Col. MOORE'S life of interest to engineers. He had been a very busy man, and connected with some of the most prominent railways in the country.

Mr. J. A. SEDDON read a paper describing experiments he had made concerning the "Settling of Water" in the settling basins of the St. Louis water-works. His paper was illustrated by numerous drawings. He also explained in detail the manner in which his experiments had been worked up and the resulting conclusions. It was ordered that the discussion of this paper be made the special order for the next meeting.

Prof. J. B. JOHNSON presented a paper on trussing the Fagin building against wind pressure. The hour being late, the paper was not read, but the professor gave a brief description, illustrated by sketches on the blackboard. It was shown that the principal danger was from wind pressure from the east. This had reached 40,000 lbs. on the exposed east face of the building, and this was supposed to have thrown the building out of plumb. Prof JOHNSON described the manner in which the building had been righted and the manner of trussing it permanently. The trussing had been calculated to withstand a wind pressure of 30 lbs. per sq. ft., and it was now considered even safer than ordinary buildings. Messrs. HOLMAN, MOORE, and ED. FLAD took part in the discussion. It was shown that few architects took any account of wind pressure in designing buildings. Col. MEIER explained a somewhat similar case at the Armory building, where it had been found necessary to put in trusses for the same purpose. Mr. HOLMAN spoke of pulsations of wind pressure which produced a cumulative effect, as noticed on stand-pipes and brick-stacks.

Prof. F. E. NIPHER made a verbal report on a recent investigation into the performance of an engine working at a fixed cut-off without governor. Measuring the brake horse-power, the pressure of the supply, steam and speed, he finds that the performance of the engine is represented by an hyperbolic paraboloid, in which the lines of constant lead and the lines of constant speed are rectilinear elements. At any fixed pressure the relation between output and speed is represented by a parabola, the vertext of which represents a condition of maximum output. The condition of maximum output at any pressure is, that the moment of the force on the brake-arm must be one-half that moment M', which will bring the engine to rest, while the speed must be one-half that speed N', which the engine would have if the load were entirely removed. The maximum output is then in horse-power,

$$\frac{\frac{1}{2}\pi}{33{,}000} M' N'.$$

Prof. NIPHER stated that he should proceed to determine whether mean effective pressure might be substituted for pressure of supply steam. His present opinion was that it could. In that case, indicated horse-power could be represented as a function of the same coordinate P and N. The equation for indicated horse-power is:

$$P N = \frac{33{,}000}{2\pi R^2 L} \text{ (I. H. P.)}$$

where R is piston radius and L is stroke.

This is also an equation of the hyperbolic parabola, the axes of which are in an entirely different position from those of the surface of brake horse-power. Both surfaces contain the pressure axis. The difference between the two horse-power ordinates will give the real engine friction for any load and speed. It follows from these equations that the work consumed in the friction of an engine is constant for all loads, if the speed is constant. The paper was discussed by Messrs. HOLMAN, GALE, and ED. FLAD.

WM. H. BRYAN, *Secretary.*

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Pittsburg & Lake Erie.—This company is building a second track between Beaver Falls and Carnopolis, Pa., a distance of 20 miles. A branch is also being built up Brady's run, just below Beaver Falls, to open up coal deposits.

Quebec Central.—It is stated that the necessary funds have been raised for the extension of this road from St. Francis to the Maine boundary line, about 46 miles.

Wheeling & Lake Erie.—The managers of this company have announced that in case the subscription pledges are fulfilled, and the right of way into Steubenville, O., is granted before July 1, they will build the proposed line from Portland to Steubenville and have it in operation before the end of the year. It is thought that these terms will be met.

Grafton & Upton.—The contractors, Newell & Snowing, of Uxbridge, Mass., have commenced work on the extension of this road from West Upton to Milford, a distance of 8¼ miles. The road was built from Grafton to West Upton, 4.6 miles, last year. H. P. BEAN, of Grafton, Mass., is chief engineer.

Confluence & Oakland.—About 500 men are now at work on this road between Confluence, Pa., and Friendsville, Md. It is expected to have the road in operation between these two places by Aug. 1.

Louisville, New Albany & Chicago.—The city of Columbus, Ind., has granted this company right of way through the city, for its proposed short line to Indianapolis, and will also build a depot and furnish terminal facilities for the road if completed.

Evansville, Suburban & Newburg.—About 4 miles of track and 10 miles of grading have been completed on this Indiana road. B. A. WOOD, of Evansville, Ind., is Chief Engineer.

Pittsburg, Fort, Wayne & Chicago.—The annual report of this company for 1888 shows the following results:

Gross earnings	$9,848,113.08
Operating expenses	7,129,360.60
Net earnings	$2,712,752.48

The rental paid to the company by the Pennsylvania Co. during the year amounted to $3,158,908, indicating a loss of $446,155 to the lessee.

Pennsylvania, Poughkeepsie & Boston.—Surveyors are now at work locating a line to Pen Argyle where, it is stated, this road will make connection with the Bangor & Portland R. R., instead of at Wind Gap as was formerly intended. Tracklaying is completed on the Hudson Connecting R. R., which runs from Campbell's Hall to Poughkeepsie Bridge, a distance of 28 miles.

Philadelphia & Reading.—The contract for double-tracking the Atlantic City R. R. has been awarded to P. McManus, of 224 North 32d St., Philadelphia, Pa.

Buffalo, Rochester & Pittsburg.—Rapid progress is being made on the Lincoln & Charlotte Park Railway, near Rochester, N. Y. Graders are at work all along the line, a greater part of the trestle work and masonry is completed, and the iron for the bridges is on the ground. Tracklaying will begin in about a month.

St. Joseph Valley.—Work has commenced on this road and it is expected to have it completed from St. Joseph, Mich., to South Bend, Ind., about 20 miles, by the middle of July. It is intended to ultimately build the road to Fort Wayne, Ind. J. BURNS, of Goshen, Ind., is President.

Evansville, Fort Wayne & Chicago.—The contractors, Keene Bros., of St. Louis, Mo., expect to begin work on this road in about 30 days.

Evansville & Terre Haute.—A tax of two per cent. has been voted by the townships of Washington, Fuget and Sand Creek in the State of Indiana, in aid of this enterprise. The amount realized will be about $100,000. It is stated that the locating surveys will begin at once and construction will follow closely.

Valley (Ohio).—It is announced that the Carnegie syndicate, recently reported as having purchased this road, has informed the majority stockholders that they will not buy. The alleged reason is that the greater part of the terminal facilities at Cleveland, which they supposed were owned by the company, are in reality leased.

New York, Ontario & Western.—The stockholders of the Scranton & Forest City, the Forest City & State Line, and the Hancock & State Line railways, covering 52 miles between Hancock, N. Y., and Scranton, Pa., have consolidated the three lines into one company, to be known as the Ontario, Carbondale & Scranton R. R. Co. Contracts for building the line have been let and the road is to be in operation by Jan. 1, 1890. The building of the new road is meeting with considerable opposition from the Delaware & Hudson and the New York, Lake Erie & Western companies, which now form the principal outlets from the Lackawanna coal fields to the north and east.

Black Diamond.—Work is reported begun on the Pittsburg, Cadiz & Ohio R. R., which is to run from Pittsburg, Pa., to Maysville, Ky. The line was surveyed some 35 years ago and about $500,000 was spent in the grading between McConnellsville and Freeport; and later on the road was built from Morgan Junction to Cumberland, on the Baltimore & Ohio R. R. ALBERT E. BOONE, of Zanesville, O., is at the head of the enterprise.

Canadian Pacific.—The International R. R., which was completed from Holeb to Mattawamkeag, Me., 129 miles, during the past year, will be opened for traffic June 2.

Providence & Worcester.—This road, running from Providence to Worcester, Mass., a distance of 43¼ miles, has been leased to the New York, Providence & Boston R. R.

Toledo, Saginaw & Mackinaw.—Surveys are in progress for the proposed extension from Tawas City along the shore of Saginaw Bay to Bay City, Mich., about 55 miles.

Middletown & Hummelstown.—The grading has been completed on this six-mile road running foom Middletown to Hummelstown, Pa., and track laying will begin soon. It is expected to have a portion of the road in operation by Aug. 1.

Central R. R. of New Jersey.—Work is reported begun on the extension of the Baltimore & Delaware Bay R. R. to Tolchester Beach, Md. It is intended to relay the entire road with steel rails and to make other improvements. Surveys are in progress for a short extension from Bayside, Del., to the shore.

Housatonic.—The petition of this road for an amendment to its charter granting it the right to build a parallel road to the New York, New Haven & Hartford, from New Haven to New York City, has been defeated in the Connecticut House of Representatives.

Rochester, Rensselaer & St. Louis.—A correspondent sends us the following:

This company has filed a mortgage in Iroquois County, Ill., to secure 2,100 $1,000 bonds. The road is to be built from Rochester, Fulton County, Ind., to Gilman, Iroquois County, Ill. Work has already begun at the eastern end of the road. JOHN K. LEE is President of the company.

Pennsylvania.—A press dispatch from Detroit states that this company will extend the Northwestern Ohio R. R. from Toledo, O., to Detroit, Mich., in the near future.

Wheeling & Lake Erie.—The grading has been completed on this road between Bowerstown and Scio, O., and the company is now laying track and ballasting. This was the first section from Bowerstown east and consisted mainly of very heavy work, there being a number of rock cuts varying from 30 ft. to 40 ft. in depth, and from 800 ft. to 1,300 ft. long. One cut 27 ft. deep, 30 ft. wide, and about 700 ft. long was made for the purpose of changing the course of Connotton creek. Fred. W. Jones, of Mount Vernon, O., was the contractor.

Chicago & Atlantic.—In response to the petition for the appointment of a receiver, for the mortgaged property of this company, by the trustees of the first mortgage bonds, VOLNEY T. NEALOTT, of Indianapolis, was appointed Receiver, and has assumed control with offices at Chicago. This cuts the company entirely loose from the control of the New York, Lake Erie & Western R. R. Co., which guaranteed the second mortgage bonds, issued in 1883.

Projects and Surveys.

Toledo & Western.—Incorporated in Ohio to build a line of railway from Toledo west to the Indiana State line. Among the incorporators are, FRANK B. SWAYNE, NOAH H. SWAYNE, HARRY E. KING, and FRANK A. CLAY.

Pittsburg, Beech Creek & Eastern.—Incorporated in Pennsylvania to build a line of railway to run from Mill Hill, Clinton county, through Center, Clearfield, Jefferson, Indiana, Armstrong, Clarion, and Butler counties to Butler, a distance of 150 miles. The capital stock is $1,500,000. SAMUEL NEVINS, of Philadelphia, Pa., is President.

Mt. Jewett, Kinzua & Riterville.—ELISHA K. KANE, of Kane, Pa., President, furnishes us with the following information:

This road is to run from Mount Jewett, Pa., across the Kinzua valley to a point on the New York, Lake Erie & Western R. R., a distance of 8 miles. The surveys have been completed from Mount Jewett to Kinzua creek, a distance of 3 miles. The grading and cross-ties will be for a standard-gauge track, but for the present 30-lb. rails will be laid with a gauge of 3 ft. The maximum curve will be 26°. The principal business of the road will be in lumber and bark. All of the right of way has been obtained. The company will do the construction work. It is expected to commence track laying about June 10, and the road will be opened for traffic by July 1. G. H. LYON, of Bradford, Pa., is Chief Engineer and ARTHUR BROWNE, of Kane, is Auditor.

Point Pleasant, Adelphi & Northwestern.—This company has been organized by E. P. BUELL and others of Adelphi, O., to build a line of railway from Adelphi southeast, through the counties of Hocking, Vinton, Jackson, and Meigs, to a connection with the Scioto Valley R. R. The object of the road is to open up the iron, coal, and oil fields of the Hocking valley. It is stated that surveys will commence at once.

Dravosburg, Reynoldston & McKeesport.—Incorporated in Pennsylvania to build a line of passenger railway, near McKeesport, Pa., 3 miles long. THOMAS REYNOLDS, of McKeesport, is president.

Philadelphia Belt.—A company has been organized to build a line of railway from Tacony, on the Delaware river, to Point Breeze, on the Schuylkill river. It is stated that the company proposes to transfer the road to the city of Philadelphi a in trust, for the use of all roads entering that city.

Sandusky, Columbus, Lake Erie & Southern.—The officers of this road, whose incorporation was noted in our issue of May 4, are, JOHN MCKILVEY, President CHAS. H. JENKINS, Vice-President; E. H. ZUHONEY,

Treasurer and CHAS. A. JUDSON, City Engineer of Sandusky, O., Chief Engineer. Surveys will begin at once on the line between Columbus and Sandusky, O.

Rochester, Beaver Falls & Western.—A press dispatch states that HENRY HARTMAN, a prominent steel manufacturer of Pittsburg, Pa., has purchased the Beaver Falls railroad together with all its right of way, franchises, etc. The company has been consolidated with the Rochester, Beaver Falls & Western Co. and will be extended to Wurtemburg, on the Pittsburg & Western R. R. JOHN REEVES, of Beaver Falls, is President.

Sandusky, Ashland & Coshocton.—It is expected that work on construction will commence shortly on that portion of the road between Sandusky and Norwalk, O., about 20 miles. Keating Bros. & Co., of Pittsburg, Pa., are the contractors. W. D. CRANE, Sandusky, O., is President.

SOUTHERN.—Existing Roads.

Richmond, Nicholasville Irvine & Beattyville.—A correspondent sends us the following under date of May 21:

The work of construction on the Richmond and Nicholasville division is progressing most favorably as regards grading, trestling, etc. D. Shanahan & Co. are the contractors and are pushing the work with vigor and rapidity. They have between eleven and thirteen hundred men engaged upon the grading and tunnelling alone besides their timber and trestle forces.

The Ohio Valley Improvement & Contract Co. are the parties building this extension of the Louisville Southern road. Its officers are Judge A. E. RICHARDS, of Louisville, President; WM. CORNWALL, Jr., Secretary and Treasurer; J. H. PEARSON, Nicholasville, Chief Engineer of the railroad company; Col. S. F. ROCK, Chief Engineer of the construction company. Col. ROCK has immediate supervision over the resident engineers on this line of the road. He reports progress at all points as being more than ordinarily encouraging.

On May 13 the Board of Directors of the construction company decided to use iron cylinders in building the bridge across the Kentucky river, near Tate's Creek ferry. The channel span of the bridge will be 300 ft. long. This contract was awarded to the Sheffler Bridge Co., of Pittsburg, Pa.

Rogers & Summit.—We are indebted to WM. O. WADLEY, of Rogers, Ga., President, for the following information concerning this enterprise:

This road is completed from Rogers to Stillman, a distance of 32 miles, and will be opened for general freight and passenger traffic June 1. The road will ultimately be extended 21 miles further. Grades and curves are very favorable. The principal traffic of the line will be in lumber and cotton. WM. M. STEVENS is Superintendent and J. D. OVERSTREET is Chief Engineer; both of Rogers, Ga.

Columbia, Newberry & Laurens.—Grading has been completed on this road from Columbia, S. C., 20 miles towards Newberry. The entire distance from Columbia to Newberry is 42½ miles and it is to be completed by MAY 1, 1890. H. C. MOSELY, of Columbia, is President.

East Tennessee, Virginia & Georgia.—The Briarfield, Blocton & Birmingham Railway Co., has been chartered in Alabama in this company's interest to build a line of railway from a point on the E. T., V. & G. Ry. near Monticello through the counties of Shelby, Bibb and Jefferson to Birmingham, with a branch to Blocton, in all a distance of 80 miles. Surveyors are now at work on the route, and as soon as the line is located contracts will be let and the line pushed rapidly to completion.

Kentucky Midland.—About 500 men are now at work on this road between Paris and Georgetown, a distance of 17 miles. About 12 miles of track have been laid since Jan. 1, 1889. J. M. DOUGLAS, of Frankfort, KY., is Chief Engineer.

Louisville & Nashville.—Work is in rapid progress on the extension of the Birmingham Mineral R. R. to the Bamberger mines.

Covington & Macon.—E. C. Machen, of Griffin, Ga., who has the contract for building the branch of this road from Griffin to Machen, Ga., has commenced work.

Kentucky Union.—Tracklaying has commenced on this road between Winchester, Ky., and Hedges, the present terminus of the road. In order that the company may obtain the $100,000 subscription of Clark county, this portion of the road must be completed by June 9. The contracts for building the road from Winchester to Lexington have been let as follows: to Mundy & Co., 3 miles; to Stack, Johnson & Co., 2 miles; to Mason & Locker, 3 miles; and to Mason & Woolfolk the remainder.

Atlanta & Florida.—The Americus Investment Co. has secured control of this road by purchase, and will extend it from Fort Valley to Cordele Ga., 42 miles, where it will connect with the Savannah, Americus & Montgomery R. R.

South Atlantic & Ohio.—This company will push work at once on the extension of its road to Big Stone Gap, Va. The road is now in operation from Speer's Ferry to Bristol, Tenn., 40¼ miles. The general offices are at Bristol.

Projects and Surveys.

East Carolina Land & Railway Co.—C. E. FOY, of New Berne, N. C., President of this company, sends us the following information concerning the enterprise:

The surveys for this road, which is to run from New Berne via Maysville and Jacksonville to Wilmington, N. C., a distance of 90 miles, will commence about the first of September. The route is through a level, heavily timbered country well adapted to the growing of early vegetables and fruits. The White Oak swamp, a tract of land containing about 80,000 acres, belonging to the State Board of Education, will be crossed by the road; and by the terms of the charter the Board is directed to turn this land over to the company as soon as the road is completed and ready for operation, receiving in payment therefor the sum of $25,000 of the first mortgage bonds of the railway company. The principal business of the road will be in timber, cotton, corn, vegetables and naval stores. About $80,000 local aid has been subscribed. The company was incorporated Feb. 12, 1889.

Monigomery & Sylacauga.—The surveys are in progress on this road. It is reported that a very favorable route is being found.

Kansas City, Chattanooga & Fort Royal.—This company, a notice of whose incorporation was given in our issue of May 11, proposes to build a railway from Chattanooga, Tenn., to New Madrid, Mo., a distance of about 275 miles. It is stated that sufficient money is on hand to make the preliminary surveys and to put the road into shape to be bonded. The officers of the company are: J. F. SHIPP, President; J. C. WALL, of Stevenson, Ala., Vice-President; and W. C. SMITH, of Wallview, Tenn., Secretary.

St. Louis & Birmingham.—Locating surveys for this proposed road are reported to be in progress. C. A. NYE, of Nashville, Tenn., is interested.

Salem & Red Sulphur Springs.—A narrow gauge railway to run from Salem, Va., to Red Sulphur Springs, about 9 miles, is talked of. F. J. CHAPMAN, of Salem, is interested.

Fernandina & Suburban.—This company, whose incorporation was noted in our last issue, proposes to build a railroad from Fernandina, Fla., to Amelia Island.

THE NORTHWEST.—Existing Roads.

St. Louis & Peoria.—We have received the following information from A. G. KLEINBECK, of Litchfield, Ill.

Herr Bros., of Litchfield, the contractors, commenced grading on 14 miles of this road, from Mt. Olive to Alhambra, on May 1. The line is under survey for a distance of 86 miles. The maximum grade is 26 ft. to the mile and the maximum curve is 3°. Right-of-way has been secured, and it is expected to have the first 14 miles finished by Aug. 1. The company was incorporated in March, 1889. D. L. WING, of Springfield, Ill., is President.

Duluth & Winnipeg.—It is announced that the bonds of this company have been placed, and that work on construction will be resumed soon.

Chicago, Milwaukee & St. Paul.—This company is reported to be about to retire all its 5, 6, and 7 per cent. bonds, most of which become due in 1890 and 1891; and to issue in their place a long term 4 per cent. consolidated mortgage bond. The proposed change will save the company about $1,000,000 a year in interest.

Northern Pacific & Manitoba.—This company has made an offer to purchase the Great Northwest Central R. R., projected to run from Brandon, Man., northwest to Battleford, a distance of 450 miles, on condition that the original land grant be confirmed by the Dominion Parliament. It is thought that this will be done. The road has been graded from Brandon, 50 miles northwest.

Chicago, St. Paul, Minneapolis & Omaha.—The surveys for the proposed extension from Hartington, Neb., to Yankton, Dak., are nearly finished and negotiations are in progress for right of way.

Canadian Pacific.—This company is reported to have entered into an agreement with the Canadian Government whereby it will build a branch line from Brandon, on the main line, southwest to the Souris coal district, a distance of 100 miles; also a line to run from the present terminus of the Manitoba & Southwestern Ry. to a connection with the Brandon & Souris branch, about 25 miles. The company is to receive the usual grant of 6,400 acres of land per mile.

Projects and Surveys.

Broken Bow & Western.—We have received the following statement from JESSE GANDY, of Broken Bow, Neb., General Manager:

Sixty miles of the preliminary survey for this road, which is to run from Arcadia, via Broken Bow and North Platte to Denver, Col., a distance of 300 miles, has been made. There will be a large bridge across the North Platte river. None of the right of way has been obtained or other local aid secured. The traffic will be principally local. The President of the company is JOHN C. MANLICK, and J. W. MATHEWS, of Broken Bow, is Chief Engineer.

Dubuque, Kansas City & Southwestern.—An effort is being made to revive this project to build a railway from Dubuque, Ia., to Kansas City, Mo. The citizens of Dubuque have subscribed $10,000 towards its construction. BERNARD J. O'NEIL, of Dubuque, is President.

THE SOUTHWEST.—Existing Roads.

Kansas City, Wyandotte & Northwestern.—This company has filed a charter in Kansas, empowering it to build a branch from Toganoxie, on the main line, to Wichita, a distance of 90 miles. The new road is to be known as the Kansas City, Lawrence & Wichita R. R.

Missouri, Kansas & Texas.—It is intended to lay a large amount of new rails on the main line of this road during the present year and to otherwise improve the roadbed. An order for 15 heavy freight locomotives has been placed with the Baldwin Locomotive Works.—It is rumored that the Taylor, Bastrop & Houston branch of the road will soon be extended to Houston, Tex., about 40 miles.

St. Louis & San Francisco.—A press dispatch from Little Rock, Ark., states that reports are in circulation that this company intends to build a branch from the main line via Eureka Springs, Batesville and Brinkley to southeastern Arkansas. The Batesville & Brinkley R. R., running from Brinkley to Jacksonport, a distance of 60 miles, and including the White & Black River Valley R. R., projected to run from Jacksonport to the Missouri State line, about 75 miles, will be absorbed in the new line.

Galveston & Western.—The capital stock of this company has been increased $80,000. The track is being changed to standard gauge.

Dallas, Pacific & Southeastern.—An issue of $4,000,000 of bonds will be made by this company to aid in the construction of their road. About 80 miles of the road, from Dallas, Tex., northwest, is now under construction.

Projects and Surveys.

New Orleans, Fort Jackson & Grand Isle.—This company has completed the surveys for its proposed road from New Orleans to Fort Jackson, about 60 miles, and is now negotiating for right of way. About $200,000 cash has been subscribed and a large amount of stock taken by the people along the route. P. S. LAWTON, of Algiers, La., is interested.

Union & Northwestern.—URIAH MILLSAPS, of West Monroe, La., President, has sent us the following:

This road is to run from Vidalia, La., via Monroe and Farmerville, to Camden, Ark. Surveys are in progress from Monroe to Camden, a distance of 20 miles. The country through which the road will run is generally level, and is well settled and well timbered. The principal traffic will be in agricultural products and lumber. Negotiations for right of way are in progress. About $30,000 of bonds have been subscribed for by the citizens of Monroe. Maj. WOODBRIDGE, of Monroe, is Chief Engineer.

Hackett City, Greenwood & Eastern.—At a recent meeting of the Board of Directors it was voted to complete the survey for this road from Greenwood, Ark., east, the survey from Hackett City to Greenwood having been made last fall. The president was also instructed to begin negotiations for right of way, looking to the early construction of the road. The road will be 25 miles long and is projected to open up the coal beds along the route. R. A. MCCONNELL, of Greenwood, Ark., is President.

Paris, Choctaw & Little Rock.—At the annual meeting of the stockholders of this company, recently held, it was voted to commence the surveys from Paris, Tex., to the Red river, about 30 miles, immediately.

ROCKY MT. AND PAC.—Existing Roads.

Union Pacific.—The Nevada Pacific Railway Co. has been incorporated in the interest of this company to build a railway from Summit, the western terminus of the Utah Central Ry., to a point on the western State line of Nevada, near the parallel of 35° 30', an estimated distance of 200 miles.—A press dispatch quotes President ADAMS as saying that estimates were being obtained for a new line to run from Portland, Ore., to Seattle, W. T. The length of the road would be about 175 miles, and it would parallel the Northern Pacific R. R. the entire distance.

Northern Pacific.—Keefe, Green & Co., of Helena, Mont., are reported to have the contract for building the 70-mile branch from Gallatin to Butte. There will be one tunnel about 1,000 ft. in length. Work will commence at once, and it is expected to have the line completed by Jan. 1, 1890.—Preparations are being made to survey the proposed line from Ft. Benton to Billings, Mont., a distance of about 200 miles.

Denver & Rio Grande.—About 1,500 men are at work on the line from Sapinero, Col., to Lake City, Col., a distance of 36 miles. Several miles of track have been laid at the Sapinero end and both tracklayers and graders are making rapid progress.

Oregon Pacific.—This company is marketing an issue of $5,000,000 of bonds to aid in the completion of its line. The road is now in operation for a distance of 136 miles, about 40 miles more are graded and ready for the rails, and 30 miles are under construction. The whole line when completed will cross the State of Oregon from east to west and will be about 600 miles long.

Southern Pacific.—The Northern California R. R. running from Marysville to Oroville, 26½ miles, has been sold to this company. It is rumored that this company is negotiating for the Nevada, California & Oregon R. R., with the intention of extending it into the San Joaquin Valley.

Vancouver, Klickitat & Yakima.—The first 10-mile section of this road from Vancouver, W. T., east has been completed.

Bellingham Bay Railway & Navigation Co.—It is stated that arrangements have been made by which this company has obtained sufficient capital to build the line from Whatcom, W. T., to New Westminster, B. C., a distance of 119 miles. About 500 men are now at work on the line between New Westminster and the International boundary.

Projects and Surveys.

Los Angeles, San Diego & Yuma.—Chartered in California to build a railway from Los Angeles to Yuma, Ariz. Among the incorporators are: WM. CARLSON,

THOS. HIGGINS, F. H. DIXON and H. T. CHRISTIAN; all of San Diego, where the principal offices will be located.

Columbia Valley & Goldendale.—Chief Engineer R. A. HABERSHAM has finished the surveys of this road from Goldendale to Pasco, a distance of 105 miles. He reports a very favorable route. Surveys will commence soon for the line from Goldendale to Portland.

Utah, Nevada & California.—Incorporated in Utah to build a line of railway to run from some point on the east line of the Territory, in the county of Emery, and through the Territory of Utah and the States of Nevada and California to the city of San Diego, Cal., a distance of about 1,200 miles. The capital stock is $20,000,000, of which $650,000 has been subscribed. Among the incorporators are FRANCIS TIERNAN, W. S. MCWILLIAMS, and H. E. GOODLANDER, all of Ft. Scott, Kan., and A. B. DEBOST, of Topeka, Kan.

FOREIGN.

Saragossa & Mediterranean.—This company is floating an issue of $7,300,000 of bonds to aid in the construction of a railway 92 miles long to run from La Puebla de Hijar to San Carlos de la Rapita, Spain. The line passes through a country which produces large quantities of wool, wheat, maize, olives and fruits of all kinds; and would receive a large traffic from Alcañiz, Tortosa and other towns along the route, all of which are largely engaged in manufacturing woolen and cotton goods, silk, paper and olive oil. The Spanish Government has subsidized the road to the amount of $1,260,000. The road from La Pueblo de Hijar to Alcañiz, a distance of about 20 miles, is far advanced toward completion, and the entire line is to be finished by Sept. 30, 1891. Señor Don MATIAS MUNTADAS, of Barcelona, Spain, is President.

Mexican Southern.—This company has issued $2,940,000 of preferred stock and $2,450,000 of common stock to aid in the construction of a railway to run from Puebla to Oaxaca, Mexico, a distance of 249 miles. The present issue is expected to complete the road from Puebla to Tecomavaca, about 139 miles. The line will be 3 ft. gauge and will connect with the Interoceanic and Mexican Central railways at Puebla. A subsidy of about $710,000 per annum will be received from the Mexican Government, for 15 years from the completion of the road. Read & Campbell, who are now building a portion of the Interoceanic R. R., have the contract for building this road, and supplying the rolling stock and other equipment, the entire line to be completed and ready for operation within 2 years from the beginning of work. James Livesey & Son, London, are the engineers.

RAPID TRANSIT.

Electric Railways.—*Beverly, Mass.*—The Beverly & Danvers electric railway will be completed by July.

Brooklyn, N. Y.—The Brooklyn City Ry. Co. proposes to use electricity, and President LEWIS, with other members of the company, has been inspecting the electric lines at Boston.

Troy, N. Y.—The Watervliet Turnpike & Ry. Co. will adopt an electric system and relay its tracks. There will be 16 motor cars, 8 of which will be able to draw another car; also 12 new cars. There will be 50-lb. side bearing rails, and 35-lb. T rails, all of steel.

Richmond, Va.—The Black's Electric Co. has been organized to operate an electric railway on a conduit system. President, W. P. DE SAUSSURE; Secretary, S. B. WITT.

Charlestown, W. Va.—The Charlestown Electric Light Co. proposes to build an electric railway.

Cleveland, O.—The East Cleveland Ry. Co. has been authorized and directed by a council résolution to extend as soon as possible the electric system over the other parts of its lines, the advantages of the system having been demonstrated.

Bloomington, Ill.—The Bloomington Street Ry. Co. has been granted an ordinance permitting it to use electricity. The Sprague or the Thomson-Houston system will be adopted. The track will also be improved. The improvement will cost $100,000.

Peoria, Ill.—The Central Ry. Co. has been granted a 20 years franchise for an electric road. The track is to be of standard gauge, laid with flat Johnson rails not less than 45 lbs. per yd. Brick paving is to be used.

Portland, Ore.—The Willamette Bridge Co. is preparing to build an electric line to Albina.

Seattle, W. T.—The Seattle Electric Ry. & Power Co. will increase its plant by 2 engines of 100 H. P. and 2 dynamos of 80 H. P.

Street Railways.—*Woonsocket, R. I.*—The Woonsocket Street Ry. Co. will extend its line to Blackstone, a distance of 1½ miles.

McKeesport, Pa.—The McKeesport Street Ry. Co. has obtained a new charter, and has increased its capital stock to $100,000.

Allegheny, Pa.—The Trans-Allegheny Ry. Co. has been organized by A. M. NEEPER and J. D. NICHOLSON, of Pittsburg; J. W. GORMAN, of Harrisburg, and others. Capital stock, $200,000. The route covers 10 miles of streets.—The Allegheny & Millvale Street Ry. Co. and the Allegheny Street Ry. Co. have been incorporated by L. H. MATTHEWS, Col. W. A. STONE, W. T. LINDSAY, and others. The capital stock of the first is $24,000, and of the second $12,000.

Pittsburg, Pa.—The Diamond Street Ry. Co. has been incorporated to build a line 5 miles long. President, A. C. HOPKINS, of Lock Haven. Capital stock, $30,000.—The Bellevue & Pittsburg Street Ry. Co. has been incorporated to build a line 8 miles long. President, GEORGE I. WHITNEY, of Pittsburg. Capital stock, $48,000.—The Second Ave. Passenger Ry. Co. has let the contract for the extension of its Market St. line to the Exposition to A. E. TOWNSEND.

Baltimore, Md.—The North Ave. Ry. Co. has been incorporated by I. S. GEORGE, FRANK SLINGLUFF, and J. M. DENISON. Capital stock, $12,000.

Charleston, W. Va.—The Charleston Street Ry. Co. has been organized by E. B. DWYER and others and has been granted a 25 years franchise. The road is to be built within a year.

Lancaster, O.—The Lancaster Street Ry. Co. has been incorporated. Capital stock, $30,000.

Miller, Dak.—A street railway is to be built between Miller and St. Lawrence.

Lamar, Mo.—A street railway is to be built to connect the railway stations.

San Antonio, Tex.—Applications for a franchise for a street railway are wanted by the mayor.

Seattle, Wash. Ty.—The Rapid Transit Ry. Co. has applied for a street railway franchise.

Vancouver, Wash. Ty.—The Vancouver Street Ry. Co. has awarded the contract for building the road to H. P. McCraney, of Vancouver. Work is to be commenced at once and completed in August.

Cable Railways.—*Peoria, Ill.*—The Peoria Cable Ry. Co. has been incorporated by VALENTINE JOBST, JAMES DOHENY and GEO. B. FOSTER. Capital stock, $400,000.

St. Paul, Minn.—It is proposed to extend the St. Anthony Hill cable road to Merriam Park.

Portland, Ore.—The Portland Cable Ry. Co. has awarded the contract for rails, yokes, pulleys, etc., to the Dunham, Corrigan & Hayden Co., of San Francisco, at $100,000. The contract for machinery, including 2 Corliss engines and 4 boilers, has been awarded to the Union Iron Works, of San Francisco, at $58,500.

Seattle, W. T.—The Queen City Ry. Co. has been organized by WM. COLLIER, ANDERSON SMITH and J. L. MURPHY, of Washington; FRANCIS PALEY of Massachusetts; WM. P. STEWART, of New York and others. Capital stock, $720,000. It proposes to build a double track on Madison St.

Dummy Lines.—*Maryville, Tenn.*—A dummy line is to be built to Maple Springs.

Anoka, Minn.—A dummy line is to be built to connect with Minneapolis.

Portland, Ore.—Proposals will be invited for the construction of the line to Waverly and Kenilworth.

Underground Railway.—*Philadelphia, Pa.*—The Broad & Market Sts. Underground Ry. Co. has been incorporated to build a four-track road. President, P. P. BOWLES; Secretary, JAMES E. SALTER. The work would cost about $25,000,000.

CONTRACTING.

Street Work.—*Brooklyn, N. Y.*—The following proposals for granite block paving have been received by JOHN P. ADAMS, Commissioner of City Works:—On Hewes St.: Charles Hart: pavement, $2.55 per sq. yd.; new curb, 60 cts. per lin. ft.; new bridge stone, 40 cts. per sq. ft.; reflagging, etc., 3 cts. per sq. ft.; line improvement, 20 cts. per lin. ft. John McNamee: $2.48, 60 cts, 45 cts., 5 cts., 25 cts. Chas. Guidet: $2.62, 62 cts., 55 cts., 5 cts., 35 cts. E. M. Lynch: $2.47, 65 cts., 50 cts., 4 cts. 70 cts. John H. O'Rourke: $2.55, 65 cts., 50 cts., 5 cts., 50 cts. Wm. Kelly: $2.48, 60 cts., 40 cts., 3 cts., 10 cts. Thomas Monahan; $2.19, 55 cts., 40 cts., 3 cts., 25 cts.—. On Johnson Ave.: Henry Mogk: pavement, $2.89 per sq. yd.; curbing, 60 cts. per lin. ft.; bridge stone, 48 cts. per sq. ft.; reflagging, etc., 2½ cts. per sq. ft. Charles Hart: $2.65, 50 cts., 55 cts., 3 cts. Chas. Guidet; $2.95-65 cts., 60 cts., 5 cts. Wm. Kelly. $2.53, 60 cts., 40 cts. 3 cts. E. M. Lynch: $2.47, 65 cts., 50 cts., 4 cts. John O'Rourke; $2.45, 65 cts. 50 cts., 5 cts. Thomas Monahan, $2.19, 55 cts., 45 cts., 3 cts.— On Smith and Jay Sts.: Wm. Kelly: pavement, $2.50 per sq. yd.; curbing, 60 cts. per lin. ft.; bridge stone, 40 cts. per sq. ft.; reflagging, etc., 3 cts. per sq. ft. Chas. Hart: $2.55, 55 cts., 50 cts., 3 cts. John McNamee: $2.48, 60 cts., 45 cts., 5 cts. J. H. O'Rourke: $2.29, 65 cts., 50 cts., 5 cts. Thomas Monahan: $2.37, 55 cts., 45 cts., 3 cts.

Omaha, Neb.—The Board of Public Works has awarded contracts for grading as follows: District No. 1 C. H. Pritchett, 10.4 cts. per cu. yd.: No. 2, Ed. Phelan, 10.9 cts.; Nos. 3 and 4, C. H. Pritchett, 10.4 cts.; No. 5 Pat Gibbon & Co., 11.2 cts.; No. 6, Pat Gibbon & Co., 13 cts. Also a contract to Ernest Stuht at 10 cts. per cu. yd.

Clinton, Ia.—The city has decided to expend $73,000 in brick paving during the year.

William's Bridge, N. Y.—The town has voted to issue bonds for $20,000 for improving the streets.

Railway.—The contract for double-tracking the Atlantic City Ry. has been awarded by Mr. H. K. NICHOLS, Chief Engineer of the Philadelphia & Reading, to P. McManes, 224 No. 32d St., Philadelphia.

Stone and Lumber.—The following proposals have been received by the Docks Commissioners, New York City: For 2,500 cu. yds. of cobble stones: John A. Bouker, 95 cts. per cu. yd.; Brown & Fleming, 95 cts. A contract was awarded to each firm for 1,250 cu. yds.—For 5,000 cu. yds. of rip-rap: J. A. Bouker, 69 cts. per cu. yd.; Brown & Fleming, 69 cts.; Alexander J. Howell, 72 cts.; West Shore Trap Rock Crushing Co., 90 cts. A contract for 2,500 cu. yds. was awarded to J. A. Bouker, and another to Brown & Fleming.—For 99,000 ft. B. M of spruce; E. W. McClave, $19 per M.; Joseph W. Duryee, $20; Richardson, James & Putney, $21.75. The contract was awarded to E. W. McClave.

Water-Works Supplies.—The Department of Awards, Pittsburg, Pa., has awarded contracts as follows for material for the Water Department. The 30-in. pipe awarded to Waters & Lawler; 16-in., Eugene Scanlon; 13 and 8-in. to Howard & Long. The 4-in., 6-in. and balance of the 8-in. was divided between Howard & Long, and Waters & Lawler. The contract for the gate valves was awarded to the Ludlow Valve Co. The contract for the various castings was given to Gagel & Co. Sellers & Co. were awarded the contract for plugs, and Mansfield & Co. the ferrules.

Harbor.—The contract for the Toronto harbor works has been awarded to Messrs. Murray & Cleveland, of St. Catherine's, Ont. who were the lowest bidders. The contract price is about $350,000.

Asphalt Paving.—The Council at Cleveland, O., has adopted an ordinance for paving Wilson Ave., between Euclid and St. Clair Ave., with Trinidad asphalt. At Wichita, Kan., the committee appointed to visit other cities and report on the best paving has recommended the use of the Barber asphalt pavement.

Training Wall.—The following proposals for constructing a training wall at Brunswick harbor, Ga., were opened May 13 by Lieut. O. M. CARTER, U. S. Engineer Office, Savannah, Ga.: David V. Howell, Monroe, N. Y. 67 cts. per cu. yd. for brush mattresses, $3.47 per cu. yd. for stone. Chas. C. Ely, Savannah, Ga.: $1.34 per cu. yd. for brush mattress, $3.41 per cu. yd. for stone.

Removing Wreck.—The following proposals for removing the wreck of the schooner *Wallace M. French* from the Patapsco river were opened May 15 by Capt. THOMAS TURTLE, U. S. Engineer Office, Baltimore, Md.: American Dredging Co., Philadelphia, Pa. $395: Louis E. Broom, Baltimore, Md., $340. The contract was awarded to Louis E. Broom.

Macadam.—The following proposals for constructing macadam roads in Essex county were opened May 13 by ADRIAN VREELAND, Clerk of Franklin Township, Franklin Co., N. J.: McKiernan & Bergin, of Paterson, N. J., 54 cts. per sq. yd., in accordance with the specifications: Wright & Gindsley, of Orange, N. J., 55 cts. per sq. yd. The contract was awarded to McKiernan & Bergin.

Rip Rap.—Major LIVERMORE, U. S. Engineer Office, Newport, R. I., has received a bid of $1.96 per ton of 2,000 lbs. for the breakwater at Block Island, R. I., from Wm. H. Molthrop & Co., of New London, Conn.

Dredging.—The following proposal for dredging in the harbor at Thunder Bay, Mich., was opened May 14 by Col. O. M. POE, U. S. Engineer Office, Detroit, Mich.: Carkin, Stickney & Cram, East Saginaw, Mich.: 40 cts. per cu. yd. scow measure.

Stone Blocks.—The following proposals for furnishing stone blocks for street paving have been received by JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y.: Fogg & Scribner: 2,000,000 blocks at $67 per 1,000. Francis H. Smith: 300,000 blocks at $78.89 per 1,000. Charles Hart: 100,000 blocks at $69.90, 200,000 at $70.40, 300,000 at $71.90, 400,000 at $74.90, 300,000 at $75.25, 400,000 at $77.40, 300,000 at $77.40, 1,000,000 at $85, 2,000,000 at $95 Staten Island stone or stone equal in quality. 500,000 blocks at $55 per 1,000, 500,000 at $60, 1,000,000 at $69.

PROPOSALS OPEN.

Dredging.—In the Illinois river. LAND CLAIM & INVESTMENT CO., Kansas City, Mo.

Sewer.—Main sewer in Wade Park Ave. W. P. RICE, City Civil Engineer, Cleveland, O. May 30.

Sewer.—Plans prepared by C. F. LOWETH, C. E., of St. Paul, Minn., and on file in the City Engineer's office. THE CITY ENGINEER, Yankton, So. Dak. May 31.

Building.—Government building at Oshkosh, Wis. JAMES H. WINDRIM, Supervising Architect, Treasury Department, Washington, D. C. May 31.

Wells.—Sinking oil wells 500, 1,000, 1,500 and 2,000 ft. deep. HENRY W. HOBSON, President, Rio Blanco Oil Co., Symes Block, Denver, Col. June 1.

Street Lighting.—Electric light or gas. JOHN CARSON, Chairman of Fire Committee, Napanee, Ont., Can. June 3.

Bridge.—Approaches and embankment of the Sandusky St. bridge. F. J. REINHARD, County Auditor, Columbus, O. June 3.

City Work.—Sewers and grading to the amount of $30,000. THE CITY TRUSTEES, Redding, Cal. June 3.

Sewer Pipe, Sand and Lumber.—Furnishing sewer pipe, sand and lumber. Also iron or wooden water tank and hydraulic ram. THE COMMISSIONERS OF ROADS AND REVENUES, Atlanta, Ga. June 5.

New Croton Aqueduct.—Cast-iron, wrought-iron or steel work; also brass, bronze or composition work, screen fencing, etc., for the new gatehouse on Section No. 1. JAMES C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York City. June 5.

Dredging.—In the Nansemond river, about 10,000 cu. yds. Lieut. G. J. FIEBEGER, U. S. Engineer office, Norfolk, Va. June 6.

Bridge Masonry.—Two abutments and 1 pier at Otter creek. FRANK ARMSTRONG, County Auditor, Terre Haute, Ind. June 10.

Dredging.—About 25,000 cu. yds. in the Wallabout channel at the Brooklyn Navy Yard. JAMES FULTON, Paymaster General, U. S. N., Navy Department, Washington, D. C. June 15.

Bridge.—Superstructure of a wrought-iron riveted-lattice bridge over the Connecticut river at Holyoke. There will be 10 spans of 160 ft.; total width, 46 ft.; trusses spaced 32 ft. c. to c. Plans and specifications at the office of the city engineer of Holyoke. LEONARD CLARK, Chairman, County Commissioners, Springfield, Mass. June 17.

Jail.—New jail and jailer's residence on the site of the present county jail. L. K. CLYDE, Clerk of County Commissioners, Greenville, S. C. June 20.

MANUFACTURING AND TECHNICAL.

Railway Material.—Rivers & Birdstup, of Franklin, La., want one mile of 16-lb. second-hand T rails and 4 or 6 trucks.

G. W. Hyde, of High Springs, Fla., wants cars, 3 or 4 miles of iron rails and tram engine, new or second-hand.

The Van Alstyne Cotton Yard Co., of Van Alstyne, Tex., wants rails and spikes for 750 ft. of track; also car wheels and axles for flat cars.

The Florida Central Ry. Co., of Fernandina, Fla., will probably be in the market for steel rails.

Cross Ties.—The Mary Lee Coal & Iron Co., of Birmingham, Ala., wants 15,000 cross-ties for a new railway.

Hand-Cars.—The Buda Foundry & Mfg. Co., of Buda, Ill., manufactures hand and push cars with wooden wheels and rolled steel tires.

The National Tube Works Co., of McKeesport, Pa., has purchased land on which to erect a storage building for supplies.

Dredge.—The DeLeon Springs Co., of DeLeon Springs, Fla., wants a steam dredge.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., have turned out another passenger engine for the New York Central & Hudson River.

The Baldwin Locomotive Works, of Philadelphia, Pa., have shipped 2 dummy engines to Evansville, Ind.

The Concord Railway has received 3 new engines, one of which, built by the Hinkley Locomotive Co., of Boston, is said to be a very powerful engine.

The Long Island Railway has received 4 new engines. They are heavier than the regular engines in use on the road.

Bicycle Locomotives.—The Portland Engine Co., of Portland, Me., has completed the second bicycle engine for Mr. E. M. BOYNTON, the inventor; and has received an order for 2 more engines which are to be of larger size than the first two built.

Cars.—The Michigan Car Co., of Detroit, Mich., has an order for 200 box cars and 100 coal cars for the Rome Watertown & Ogdensburg.

The Indianapolis Car Works, of Indianapolis, Ind., has completed 100 fruit cars for the Louisville & Nashville.

The Ohio Falls Car Co., of Jeffersonville, Ind., has turned out a private car for the president of the Chattanooga, Rome & Columbus. The company has orders for 100 box cars and 100 flat cars for a Southern road.

The Pullman Palace Car Co., of Pullman, Ill., has an order for 10 cars for the Concord road.

The Ohio & Mississippi has contracted for 50 refrigerator cars.

Asphalt Paving.—HENRY BOLZE, of New York, issues a pamphlet of information relating to Sicilian rock asphalt for roadways and Limmer asphalt mastic for sidewalks, etc.

Sewer Pipe and Fire Brick.—Evens & Howard, of St. Louis, Mo., manufacturers of St. Louis standard sewer pipe, 3 to 24 ins. diameter, and fire brick gas retorts, have issued an illustrated and descriptive catalogue of fire brick, fire clay, retorts, furnace linings, gas furnaces, lime kilns, pipe, culverts, etc. Prices are given. The output for 1888 was 50,000 tons.

Rail Joint.—The Continuous Rail Joint Co. has been organized by FREDERICK T. FEAREY, A. W. THOMPSON, and F. C. RUNYON, of Newark, N. J., to manufacture the joint patented by F. T. FEAREY. Capital stock, $100,000.

Street Rail.—A new form of saddle rail, to rest on iron chairs, has been designed by R. T. WHITE, of Boston, Mass., manufacturer of street railway material. The wearing part of the rail is a compromise between the ordinary side bearing rail and the English grooved rail.

Spark Arrester.—The Union Pacific has had an engine fitted at the Omaha shops with the new smoke-stack arrangement designed by Mr. CUSHING, Master Mechanic.

Steel Works.—The Newport (Ky.) Iron & Steel Works, were sold May 4, at Cincinnati, O., to JOHN W. SHREIDER for $67,000. He is supposed to have made the purchase in the interest of the sureties for $100,000 indebtedness of the concern.

Locomotive Bell Ringer.—An apparatus for ringing the bell of a locomotive by steam or compressed air has been invented by J. W. LYMAN and GEO. E. MCCOMBER, of Saratoga, N. Y.

Rock Drills.—The Ingersoll-Sergeant Rock Drill Co. has established a branch house at 26 South Water St., Cleveland, O., for the sale of its drills and air compressors. Mr. EDGAR INGRAHAM is Manager.

Cupola.—VICTOR COLLIAU, of Detroit, Mich., is the inventor and sole manufacturer of the improved Colliau cupola. He has a plant in running order, and has several orders on hand.

Water-Works Material.—The Galvin Valve & Hydrant Co., of Detroit, Mich., has secured the contract for furnishing the valves and boxes for the new water-works at Dowagiac, Mich., and the valves and hydrants for Dodge, Mich. The company has recently shipped valves and hydrants to Columbus, Neb., and has completed a contract at St. Paul, Minn., for valves and brass work.

BRIDGES AND CANALS.

Bridge Notes.—*Holyoke, Mass.*—The County Commissioners have awarded to Wright & Lyon, of Greenfield, the contract for the stone masonry of the new bridge, at $22.50 per cu. yd.

Windsor Locks, Conn.—The canal company will build a new iron bridge at a cost of $2,500. H. R. COFFIN is superintendent.

Cazenovia, N. Y.—The Elmira, Cortland & Northern bridge has been strengthened in consequence of the heavier engines and rolling stock now in use.

Brooklyn, N. Y.—The Bridge Committee will build a new bridge over Newtown creek, and proposals will be opened May 28 at the County Court House.

Buffalo, N. Y.—The bill to authorize the Canadian Pacific to build a bridge over the Niagara river has been defeated in the State senate.

Lockport, N. Y.—An iron bridge is to be built over Tonawanda creek, and proposals for the stone abutments will be received by JULIUS FREHSEE, Surveyor, on May 27.

McKeesport, Pa.—The Dravosburg & Reynaldton Bridge Co. has decided to increase its capital stock and build the Monongahela river bridge at once.

Baltimore, Md.—The city has appropriated $60,000 for the Cedar Ave. bridge across Jones' falls.

Asheville, N. C.—The Asheville Toll Bridge Co. will build an iron bridge of 2 spans, 200 ft. long and 30 ft. wide.

St. Augustine, Fla.—The St. Augustine & North Beach Ry. Co. wants proposals for bridging the North river.

Florence, Ala.—The County Commissioners have awarded contracts for 2 bridges to the King Iron Bridge & Mfg. Co., of Cleveland, O.

Defiance, O.—The County Auditor will receive bids June 14 for an iron bridge of 3 spans of 119 ft. each across the Maumee river; roadway 18 ft. wide; height of truss not less than 24 ft.; capacity 80 lbs. per sq. ft. of floor.

Lafayette, Ind.—The County Commissioner will build a high truss wrought-iron bridge over the Wabash river at Main St.; 1 span of 181½ ft., 2 of 180 ft., c. to c. of pins; 11 panels; truss 29 ft. deep c. to c. of chords; 25 ft. of roadway and two 8-ft. walks. Trusses to be proportioned for 3,000 lbs. rolling load per lin. ft. in addition to weight of bridge; floor beams, beam hangers, hip verticals and sidewalks proportioned for 100 lbs. rolling load per sq. ft. of floor; coefficient of safety of 4. Bids opened May 30 for abutment and May 31 for superstructure. EVERETT B. VAWTER is engineer and superintendent.

Bismarck, Dak.—The contracts for 3 small iron bridges have been awarded by R. R. MARCH, County Auditor, to the A. G. Bayne Mfg. Co., of Minneapolis, Minn, at $1,700.

Kansas City, Kan.—The County Board has awarded the contract for the Island creek bridge to the St. Louis Bridge & Iron Co. for $993.——The Keystone Bridge Co. has the contract for the superstructure of the Winner bridge. Work is to be commenced early in June.

St. Helena, Ore.—The County Judge is advertising for bids for the construction of 3 bridges in the Nehalem Valley.

Bothell, Wash. Ty.—A bridge is to be built over the Samamish river. Span 35 ft., 16 ft. wide, approaches 600 ft. long. Bids will be opened by the County Board on June 5.

Council Bluffs, Ia.—The following proposals for bridges have been received by F. STIMSON, City Engineer: Missouri Valley Bridge & Iron Works, Leavenworth, Kan.: for 3 truss girder iron bridges, 4 panels, wooden floor beams, $6,150 with pin connections, $6,050 with riveted connections. Kansas City Bridge & Iron Works, Kansas City, Mo.: $6,300 with 3 panels, $6,350 with 4 panels. Wrought Iron Bridge Co., Canton, O. (J. H. Hoover, Kansas City, Mo.), $6,500. Smith Bridge Co., Toledo, O., $6,500. Minneapolis Bridge Co., $6,495. The Milwaukee Bridge & Iron Works, of Milwaukee, Wis. (C. E. H. Campbell, Council Bluffs, Ia.), was awarded the contract for 3 plate girder bridges (being the only bidder for plate girders) 50 ft. span on iron tubular piers, 2 ft. 9 ins. diameter; driveway 26 ft. wide; 2 sidewalks 5 ft. wide; floor joists of steel, carrying capacity 3,000 lbs. per lin. ft.: total of 3 bridges, $7,479. Also lowest bidder for iron truss girder bridges, wooden floor beams, $5,979, or $600 extra for steel beams.

Canals.—*Florida.*—A bill has been introduced into the State Legislature to incorporate the Ocklawaha Canal Co.——A drainage canal 6 miles long from Baldwin to Deep creek is being constructed by W. J. White.

New York.—The Assembly and Senate have passed a bill appropriating $600,000 for the canals.

Dam.—The new dam at the locks at Appleton, Wis., is nearly completed. It is provided with 5 sluices.

Philadelphia, Pa.—Mr. WAGNER, Director of the Department of Public Works, has received the following bids for the piers for the new Schuylkill river bridge at Walnut St.

Frogg & Scribner: four main piers, $176,500; small trestle piers, $975 and $900 respectively, long trestle piers, $162 and $149 respectively. R. A. Malone: main piers, $171,000; small trestle piers, $500 and $400; long trestle piers, $75 and $60. Albert G. Sparks and S. W. Evans: main piers, $292,000; small trestle piers, $663 and $564; long trestle piers, $82.50 and $70 and $72. R. C. Ballinger & Co.: main piers, $131,500; small trestle piers, $271 and $193; long trestle piers, $57.80 and $47.50. Sooy Smith & Co.: main piers, $185,000; small trestle piers, $600 and $450 each; long trestle piers, $87 and $70. I. H. Hathaway Co.: main piers, $120,000; small trestle piers, $375 and $300, and long trestle piers, $56 and $49.

ELECTRICAL.

Electric Lighting.—*Dexter, Me.*—The Dexter Illuminating & Power Co. has been organized, President C. B. STORY; Treasurer, G. D. HUGHES. Capital stock, $9,000.

Providence, R. I.—The city has made a contract for 300 electric lights at 44 cts. per lamp per night for 3 years.

Hudson, N. Y.—The Hudson Electric Light Co. has awarded the contract for its power station to GEO. E. ROOSA, at $8,230.

Albion, N. Y.—The Jordan Electric Light Co., which uses the Thomson-Houston system, has offered to furnish 23 arc lights for 240 nights per year at $60 per light.

Sea Isle City, N. J.—The City Council has appropriated $2,000 for electric lighting.

Mauch Chunk, Pa.—The Mauch Chunk Heat, Power & Electric Light Co. wants arc and incandescent light dynamos put in, poles put up and wires strung.

McKeesport, Pa.—The electric light company has offered to supply 30 arc lamps of 2,000 c. p. at $100 per annum.

Baltimore, Md.—The Pennock Electric Light & Power Co. has been incorporated by GEO. P. PENNOCK, of Chattanooga, Tenn., H. C. WINCHESTER, B. S. JOHNSON and others. Capital stock, $500,000. The company will control the Pennock patents for the "electrolyte compound."

Macon, Ga.—A company is to be organized to put in an arc and incandescent plant.

Milledgeville, Ga.—The town will issue bonds for putting in electric light.

Wabash, Ind.—The electric light plant has been acquired by a new company, which will put in a Heisler incandescent system for lighting buildings. Geo. Webster, Jr., of Chicago, is secretary.

Alton, Ill.—A new contract for lighting the city has been made, and is to continue for three years. Heretofore the electric and gas lights were run on what is known as the Philadelphia schedule; but as it was a source of trouble ever since its existence, it was abolished and a new schedule arranged, whereby every lamp in the city is to burn all night throughout the year, except on bright moonlight nights, for which the city is to pay $90 for electric and $24 for gas lights.

Sioux City, Ia.—It is proposed to put in an electric light system to be owned and operated by the city. The cost would be about $15,000 exclusive of the power house.

Atchison, Kan.—The Pennock Battery Electric Light Co. has been incorporated. Capital stock, $250,000.

Superior, Neb.—A franchise has been granted for an electric light plant, which is to be in operation in 90 days. It will be run in connection with the water-works.

Redwood City, Cal.—The Redwood City Electric Light Co. has been organized by A. J. MARCUS, ALBERT HANSON, J. L. Ross and others. Capital stock, $20,000.

London, Ont.—A Heisler plant of incandescent lights of 10 to 100 c. p. is to be put in.

WATER AND MUNICIPAL.

Portland, Me.—The Munjoy Hill reservoir, now under construction, covers an area of 4 acres and has a depth of 47 ft. The sides have a slope of 1½ horizontal to 1 vertical, and are lined with a mixture of clay, sand and gravel 6 ins. thick, the lining being well rolled with a grooved roller. On this is laid a bed of machine broken stone 6 ins. thick and upon that the granite blocks. About 200 men are now at work. The engineer is Mr. J. HERBERT SHEDD, of Providence, R. I.

Atlanta, Ga.—The Water Commissioners have issued their report for 1888. The Hyatt filter is said to work satisfactorily and to be in good condition. The Superintendent recommends that consideration be given to the question of increasing the water supply; the greatest amount that can be pumped from the artesian well is 200,000 galls. per day. During the year there were 23,119 ft. of pipe laid, and 53 valves and 48 hydrants set; there are now 31 miles, 1,562 ft. of pipe, 389 hydrants and 2,028 meters. The total amount of water pumped was 628,931,300 galls; and from the artesian well 10,537,780 galls. WM. J. RICHARDS is superintendent.

Boston, Mass.—Chairman Grant, of the Water Board, has sent to the Board of Aldermen an important communication in reference to the new basin (No. 5) in the town of Hopkinton. The Water Commissioners state that unless the City Council allows the Board to begin during the present season the work of constructing the new basin, the water supply of Boston is likely to be inadequate for the needs of the inhabitants before a basin can be built. The Board states that it declines to assume the responsibility of further delay in connection with the matter. The communication states that an appriation of $35,000 was made two years ago, and all but 95 acres of the necessary land was purchased. This land was held at a much higher price than its worth, and the Board desires to take it by right of eminent domain. Although the greater portion of the land for Basin 5 was bought two years ago, owing to the dilatory action of the City Council the Water Board has been unable to make any progress. The capacity of the present Cochituate and Sudbury works in a dry year is 35,500,000 galls. daily, and the average daily consumption for 1888 was 33,000,000 galls., which leaves a very small margin, especially in view of the fact that it will be 5 years before the basin can be finished. The new basin will add 4,500,000 galls. daily to the supply, which will be none too much by the time the basin is completed. The estimated cost of the new basin is $750,000. A preliminary loan of $150,000 will be sufficient for the work of the first year. The Board emphasizes the fact that something should be done at once.

Jackson, Miss.—The Jackson Water-Works Co. made an official test of its works May 10, under the supervision of Mr. EUGENE CARROLL, engineer for the company, and Mr. E. H. BURLINGAME, engineer for the contractor. Six streams were thrown through 100 ft. of hose to a horizontal distance of 135 ft., equivalent to 90 ft. vertical. There are 13 miles of 4 to 12-in mains and 101 hydrants. The hydrant rental is $60 and the works cost $100,000. The water is pumped by 2 Deane pumping engines of 1,000,000 galls. capacity to a stand-pipe 24 ft. diameter and 60 ft. high.

Portland, Ore.—In consequence of the growth of the city and the consequent increase in consumption of the water, the Water Committee proposes to put in an additional pump, and to lay an additional pipe line from Palatine hill to the 6th St. reservoir. The $100,000 in bonds which the committee is authorized to issue, together with the surplus earnings to May, 1890, will cover the cost of the work. The cost of a high duty engine of 10,000,000 galls. daily capacity, as recommended by the Superintendent, and a 24-in. pipe, is estimated at $150,000.

Winona, Minn.—The Winona Gas Light Co. has now 8 miles of mains and proposes to make further extensions. President, H. W. LAMBERTON; Secretary and Manager, H. C. BOLCOM.

Columbus, O.—Superintendent MCALPINE has presented his report for the year ending March 31, 1889. There were 19 miles, 3,882 ft. of pipe laid and 141 hydrants set during the year, making totals of 90 miles 50 ft. of pipe and 710 hydrants. The total pumpage was 2,258,878,483. The improvements now under construction include new pumping station, machinery, water supply, main pipe lines and all necessary connections complete. The estimated cost is $260,000, of which $52,993.59 has been paid for pipe lines, machinery, etc., leaving an estimated balance to be paid of $207,006.41; the estimated amount available is $212,730.18, leaving a surplus of only $15,723.77, so that no extensive pipe-line extensions can be undertaken.

Syracuse, N. Y.—The proposition to create a Water Board and to issue bonds for the establishment of waterworks by the city will be voted on at a special election June 4. It is intended to obtain the supply from Skaneateles lake, and the Syracuse *Standard* says: "It will not do to make a pretence in that direction, and having created a Water Board and pawned the credit of the city, wait until next winter for authority to seek a supply elsewhere. A fate favorable to the scheme can only be made certain for it on the pledge that it is for Skaneateles lake that votes are asked."

Salem, Mass.—The Water Board has made its report for 1888. A careful examination of the syphon and pipes was made, and the joints were found tight and in good condition. The total amount of water pumped during the year was 770,814,400 galls, of which a large amount was wasted. There were 1,419 ft. of pipe laid, 1 hydrant and 5 gates set; there are now 378 hydrants and 137 meters. B. S. GRUSH is Superintendent.

Buffalo, N. Y.—The Water Commissioners have issued their report for 1888. During the year extensive improvements were made on the inlet pier and tunnel, the latter being enlarged from 4 ft. to 6 ft. diameter, and its present capacity is 100,000,000 galls. per day. The new Gaskill engine and 4 boilers have been put in by the Holly Mfg. Co. There were 21 miles, 1,250 ft. of pipe laid, 146 hydrants, 3,182 taps, and 231 valves set, bringing the totals up to 252 miles 403 ft. of pipe, 2,286 hydrants, 32,650 services, 87 meters and 28 hydraulic elevators. The waste is said to be 70 per cent. of the amount pumped, and the general introduction of meters is recommended. The report contains a map, and very complete statistical table. The total amount of water pumped was 15,545,365,450 galls. LOUIS H. KNAPP is Engineer and Superintendent.

Water-Works.—*New Hampshire.*—Canterbury. A water supply is to be established.

Massachusetts.—North Brookfield. Water-works are needed and it is proposed to apply to the Legislature for power to issue bonds for this purpose.

Rhode Island.—Providence. An additional appropriation of $50,000 has been made for the Fruit Hill reservoir. ——Central Falls. The Water Commissioners have been authorized to renew the contract with the Fire District for a water supply, if satisfactory terms are made.

New York.—Brooklyn. Mr. ADAMS, Commissioner of City Works, has sent in his estimate of water expenses for 1890; the amount is $641,027, an increase of $140,000 over the appropriation for the present year, this is due to the extension of the driven-well system and the purchase of new engines. An appropriation of $137,690 is asked for extending the facilities for the distribution of water from the Ridgewood and Prospect Park reservoirs; the work calls for 1,866 tons of pipe, 78 tons of specials, 258 hydrants, valves, etc.——Tarrytown. The Water Commissioners have issued $60,000 of water bonds.——Glens Falls. The Village Clerk has been authorized to purchase 5,800 ft. of 6-in. and 1,844 ft. of 4-in. water pipe.——Sag Harbor. Pipe laying has been commenced.——Albany. A preliminary trial has been made of the pumping plant which is to be used to test the new water supply from the driven wells.——Rochester. The Council has adopted the report of the Water-Works Committee recommending that pipe extensions be made to the extent of $51,679. A resolution was adopted to investigate the statement that only 50,000,000 galls. of water per day are allowed to pass through the Hemlock lake stop-gate, although the capacity of the conduit is 90,000,000 galls.

New Jersey.—East Orange. Work has been begun on an improvement at the water-works which will about double the present water supply of 1,500,000 galls. per day. A large aqueduct 725 ft. long, 10 ft. wide, and 20 ft. deep is to be built of solid masonry, and three new wells, two 25 and the other 50 ft. are to be built, furnishing about 1,250,000 galls. per day.——Bloomfield. The Montclair Water & Gas Co. has elected Dr. J. J. H. LOVE, President and WM. H. BALDWIN, Secretary.

Pennsylvania.—Wilkins. The Rural Water Co., capital stock $500, and the Valley Water Co., capital stock $500 have been incorporated by JOHN D. CHERRY, E. J. HARLAND and R. S. FRAZER.——Carlisle. The Carlisle Gas, Water & Electric Light Co. has increased its capital stock $20,000, and elected W. W. DALE as President.——Mechanicsburg. The Mechanicsburg Gas & Water Co. has elected JOSEPH LEAS, President, and J. C. BOWMAN, Secretary. —— Rochester, Pa. The water question is again being agitated.——Harrison Township. The Harrison Township Water Co. has been incorporated at Harrisburg with a capital stock of $2,500.

Maryland.—Baltimore. The Water Committee has decided to report in favor of the appointment of engineers to report on the proposition to bring water from the Gunpowder river by gravity. Estimated cost, $2,000,000. ROBERT K. MARTIN is Chief Engineer of the Water Department.

District of Columbia.—Washington. The 48-in. supply pipe is now being made by the Camden, Gloucester and McNeal works; plans for the Rock creek trestle have been prepared, the contract for hauling pipe has been let to Springman Bros., and contracts will soon be awarded for trenching, but this work will not be started before September. The pipe will connect the distributing reservoir above Georgetown with the present 48-in. main, crossing Rock creek on an iron trestle.

Virginia.—Gordonsville. The council has appropriated $80,000 for water-works.——Green Forest. The Buena Vista Co. will build water-works.

South Carolina.—Charleston. In a recent council discussion over the water supply question, the mayor stated that the company had an abundant supply of water; but unfortunately the terra-cotta mains that had been laid to connect the two reservoirs had been found to be unserviceable, and nothing could be done until they had been replaced with iron mains. The company had already taken steps to do this. It had been suggested that the present service of pipes might be temporarily used for the purpose of utilizing the water in the upper reservoir.

Georgia.—Milledgeville—A gravity system of waterworks is to be bu lt by Samuel Walker; the water will be conveyed 2¼ miles through iron pipe.——Atlanta. The Water Commissioners have recommended an appropriation of $10,000 for investigations with a view to increasing the water supply.

Alabama.—Fort Payne. The contract for waterworks has been let to E. Sutphin, who has commenced work.

Mississippi.—Vicksburg. The Vicksburg Water Supply Co. has had considerable trouble with its suction mains, owing to the settling of the ground. Repairs are being made.

Tennessee.—The water-works are nearly completed; 6 miles of pipe were laid during the past year.

Kentucky.—Georgetown. Patterson & Nichols have the contract to build the water-works.——Jeffersonville. The Water Commissioners have ordered service pipes to be placed at the court house and county jail.——Harrodsburg. The city has made a provisional contract with the Harrodsburg Water Co. for 20 years at $2,850 per year; if the contract is ratified by the public vote on June 8 the company will build the works; the water will be pumped to a stand-pipe.

Ohio.—Fostoria. The vote taken May 13 on the question of issuing $200,000 in bonds for water-works resulted in 428 for and 328 against.

Indiana.—Columbus. The water supplied by the water-works is reported by the City Health Board to be polluted and unfit for use.

Illinois.—Alton. The question of the city buying the water-works is again being agitated. The company, when the subject was undergoing a discussion several years ago, offered to sell to the city, but the proposition fell through. Since then the company has spent several thousand dollars in improvements, and it is considered doubtful if it would now consent to a transfer of the property.—— Carlinville. The water company has let the contract for digging the trenches, and the work of laying the mains will be commenced at once. It is expected to have the works completed and ready for operation by September. The water supply will be obtained from a reservoir constructed on Macoupin creek, southeast of the city.

Iowa.—Rock Rapids. Water-works are projected.—— Mt. Vernon. It is proposed to put in water-works, the supply to be obtained from artesian wells.——Colfax. A new pump will probably be purchased.

Minnesota.—St. Paul. The city has sold $100,000 water bonds to Kidder, Peabody & Co., of Boston, Mass., at $109,715.——Minneapolis. One of the new Worthington pumps at the North Minneapolis pumping station has been put in service; it has a daily capacity of 15,000,000 galls.

Nebraska.—Crete. The water company is sinking trial wells to locate a source of supply.——Osceola. The water-works are nearly completed.

Dakota.—Aberdeen. New mains are to be laid to connect the present system, which is supplied by an artesian well, with the artesian well used now to run the sewer pump; this will give an additional emergency supply.

Missouri.—Chillicothe. The Grand river is said to be encroaching on the banks near the pumping works.—— Independence. A new company contracted some time ago to purchase the works, but the transfer has not yet been made.

Texas.—Fort Worth. The Water-Works Committee has reported in favor of adding an 8,000,000-gall. pump and 10 6-in. gang wells to the water-works, and extending the mains at a cost of $20,000.——Terrell. The asylum water tower collapsed May 12. It was a brick structure 40 or 50 ft. high.

Colorado.—Central City. The Mayor opens bids to-day for $30,000 7 per cent. water bonds.

Oregon.—Umpqua City. Work has been started on the new works.——Portland. The Oregon Iron & Steel Co. has completed the delivery of the 2,000 tons of pipe contracted for; it will take about two months longer to lay the pipe.

Utah.—Salt Lake City. The following are the direct measurements taken by the Water Commission in the neighboring cañons: City Creek, April 23, 5,635,799 gallons flow in 24 hours; Dry Cañon, no measurement taken, as all the water there will barely fill a two-inch pipe; Red Butte Cañon, April 26, 1,094,699 gallons; Emigration, same date, 1,013,444 gallons; Parley's Cañon, April 27, 3,597,236 gallons; Mill Creek, May 5, 7,171,574 gallons. The flow past the Hanauer smelter is 11,000,000 gallons, to which may be added 2,000,000 gallons already stolen up toward the Bench. The Cottonwoods will be measured next.

Special Reports of Water-Works Construction.

Northfield, Vt.—The following is from L. F. BELLINGER:

A survey for water-works to be owned by the town is now being made by three seniors in the course of civil engineering at Norwich University, who will make plans and estimates. The works will probably be constructed, as some other towns in the State have recently built works very cheaply. The water-works committee is: C. A. EDGERTON, Jr., PAGE HARRIS and L. F. BELLINGER.

Dedham, Mass.—The facts below were given by WM. F. HILL, Superintendent:

A new stand-pipe is being built. It will be used as a storage reservoir, and will be 42 ft. in diameter by 51 ft. high, placed on an elevation 52 ft. higher than the foundation of our present stand-pipe.

Saratoga Springs, N. Y.—SAMUEL F. COREY, Secretary, informs us that the new 8,000,000-gall. Holly-Gaskill pumping engine, now being placed, is expected to be ready for use on June 1, when the works will have a pumping capacity of 13,000,000 galls.

McKeesport, Pa.—The following is from JOS. ESCOFF, Superintendent:

A high-service system is being discussed. If built it will include a new pumping station at the present reservoir, with two 1,500,000-gall. pumping engines. Also 3 or 4 miles of 4, 6, 8, and 12-in. mains, and a stand-pipe 20 ft. in diameter by 160 ft. high, to be built on an eminence 52 ft. above the reservoir, giving a total elevation of 212 ft., and of 517 ft. above the river. Probably a part of this work will be done this year, and extensions made next year, according to the demand. Extensions are now being made to the present system in the way of mains and hydrants.

Hampton, Va.—H. B. BOOKER, Secretary of the Hampton Water Co., has given us the following information:

Capital for the construction of works has been secured by the above company, and contracts will be let by July 1. Water will be pumped to a stand-pipe at an estimated cost of $40,000. The officers are: President, C. S. HOLTZCLAU; Treasurer, J. A. WATKINS; Secretary, H. B. BOOKER.

Bellevue, O.—The following is from J. L. PAINTER:

The city has voted $25,000 for improving the water-works. A stand-pipe 20 ft. in diameter by 100 ft. high will be erected, and two miles of cast-iron mains laid this summer, but the principal industries are in the line of trade. For further information address Councilman C. A. BOSWORTH, Wilmington, O.

Washington C. H., Ohio.—We are indebted to FRANK JOHNSON for the following:

H. E. HUNTINGTON, of Cincinnati, and associates, are furnishing money to put in works. Contracts for pipe-laying have been let to——CARUTHERS, and the Addyston Pipe Co. already has some of the pipe on the ground.

The original franchise was granted to JNO. P. MARTIN, of Washington C. H., early in 1888. Under its provisions water was to be lifted to a reservoir by two pumps having a combined daily capacity of 3,000,000 galls. The franchise provided for 125 fire hydrants at an annual rental of $40 each.

Wilmington, O.—We are also indebted to Mr. JOHNSON for the following:

Water-works are being considered. There are some manufactories.

Mt. Pleasant, Mich.—The Superintendent, WM. DIXON, reports that there has recently been quite a decrease in the number of consumers, owing to a report that the water was unfit for use. Upon investigation this was found to be "partially true," and measures are now being taken to remedy the trouble.

Jerseyville, Ill.—The following is quoted from a letter from GEO. C. MORGAN, of Chicago:

On May 25, 1887, I entered into contract with that city, (Jerseyville) which was duly signed, sealed and delivered to me, for the construction of a system of water-works. In the beginning, it was decided by the Council that the water supply was insufficient, and an artesian well ordered.

On this account my work was suspended for 18 months. In the meantime there was a depreciation of values on the whole work to the amount of about $7,000, which I was perfectly willing and offered to estimate to their advantage, although entirely optional with me to do, as it was my fortune and not theirs, and had there been an *increase* in values, the *loss* would have *surely* been mine. However, as it was, and for political reasons, and with a great show of saving money, etc., they found it convenient to find technicalities (chiefly the clerk's neglect to properly record the contract) upon which they based their claims. I make this explanation, as it has been generally understood by the contracting world that I had the Jerseyville work; but my contract has been entirely ignored, and the work recently re-advertised, and let to the Rockford Construction Co., upon plans and specifications furnished the city by me. If I ever had a contract I have got one with the city of Jerseyville, and it is of interest to all contractors to know whether or not a city can make and break contracts at pleasure. I am well advised that in this case they cannot; but the courts will have to decide.

In addition to the above Mr. MORGAN states that the works were designed by him, that construction was begun in April, and that there will be about six miles of cast-iron pipe and 29 hydrants. Water will be pumped from an artesian well to a Morgan's special water tower, and there will also be a brick reservoir with a capacity of 150,000 galls. There will be duplex, high-pressure pumps, with a daily capacity of 150,000 galls. The estimated cost is $23,000. Population, 4,000.

Norwood Park, Ill.—Mr. MORGAN also gives us the following:

The works were designed by, and the contract awarded to, GEORGE C. MORGAN, of Chicago, who began construction in March, and will finish July 1. Water will be pumped from an artesian well to a Morgan's special water tower, and there will be a ground reservoir. There will be a 300,000-gall. duplex pump, and 2¼ miles of Wyckoff wood pipe. Estimated cost, $11,000. Population about 750.

Glenwood, Ia.—The following is from SETH DEAN, engineer for the work done thus far:

The village has a population of 2,000, and has contracted with the American Water-Works Co., of Aurora, Ill., for an artesian well, which is now being sunk. Bonds have been issued to pay for the well, and if it proves successful more bonds may be issued, and water-works built. P. P. KELLEY is mayor.

Grant, Neb.—The following information is from J. L. BEARD:

Water-works will be built by the Lincoln Land Co. between June 1 and Nov. 1, at a cost of about $10,000. Water will be pumped from a deep well to an elevated tank. There will be two miles of mains. P. O. PHILLIPS is Secretary of the company. Population, 500.

Devils's Lake, Dak.—C. M. FISHER, City Auditor, informs us that the contractors have an artesian well down 1,520, where they claim to have struck 80 ft. of quicksand, which they cannot overcome.

Horton, Kan.—The following is from A. X. CAMPBELL:

Works are being built by A. L. STRANG, Omaha, who owns the franchise and is the engineer. Water will be pumped from a system of wells, using both a stand-pipe and direct pressure. Estimated cost, $50,000. Works will be finished by Sept. 1. Population, 5,500.

Baird, Tex.—W. C. POWELL informs us that there is talk of taking a gravity supply from a "subterranean lake," 200 ft. above and 2½ miles from the town. The lake has a drainage area of 40 sections of "sand ruff." Water is found 30 ft. below the surface. Population 1,200.

Centralia, Wash.—The following is from T. K. BARNUM, Superintendent and Manager of the Centralia Water Co.:

Construction of works for the above company was begun April 20. For the present, water will be taken by gravity from springs 150 ft. above the town, at a cost of $8,000. Later mains will be run for 4½ miles up the Scoopenchuck river for a gravity supply with a head of 105 ft. These works are estimated to cost $25,000. Most of the money will be furnished by local business men. F. S. SPRAGUE is President. Population, 1,500.

North Yakima, Wash. Ty.—City Clerk GEO. W. RODMAN has given the following:

Works will be begun at once, and finished Dec. 1, by Geo. F. Woolston, 5 Tremont St., Boston. Water will be pumped from the Natchez river directly to the mains.

Wallula, Wash. Ty.—I. G. DAVIS, Secretary of the company, has given the following:

The Wallula Water & Motive Power Co. has for its President, WM. MASTIN; Secretary, L. G. DAVIS. Surveys have just been completed (May 13) for a gravity supply of water from the Walla Walla river.

Ashland, Ore.—MILTON BERRY, City Recorder, writes to the effect that the town wishes to put in works this summer, but that plans and estimates have not yet been made. They wish catalogues from manufacturers. Water will be taken from a mountain stream, by gravity.

Boucherville, P. Q.—I. A. DEMERS has given the following:

A private company, not yet fully organized, proposes to put in works immediately, at a cost of $5,000 or $6,000. A yearly revenue of $800 to $1,000 has been guaranteed. Population, 1,000.

St. Lambert, P. Q.—J. A. GARIEPY, engineer of the Longueuil water-works informs us that the population of St. Lambert is 700 or 800, about 3 miles from Longueuil. There has been some talk of water-works. Water is now taken from the St. Lawrence and from wells.

Notices of The Manual of American Water-Works.

The Manual will be invaluable to civil engineers, statisticians, editors and municipal officers.—Lincoln (Neb.) *State Journal.*

The work is an important one, showing as it does in detail the means of water supply of a very large number of cities and towns of the country.—*Spectator* (N. Y.)

I have received the Manual of 1888 of American Water-Works, and find the same very valuable and interesting. —CHAS. B. BRUSH, Civil Engineer, Chief Eng. and Supt. Hackensack Water Co.

It presents in convenient reference shape a great mass of data concerning the water-works of the country. *Journal* (Sioux City, Ia.)

There is also a great deal of miscellaneous information and statistics about the water supply of cities, the collection and systematic presentation of which must have involved immense labor. The volume will prove a valuable work for reference. *Times* (Cincinnati).

It will be eagerly sought after by all water-works men and capitalists. *Republican* (Denver).

The Manual is certainly of great value to all interested in the construction or management of systems of water-works, or to the consumer who may desire information on the subjects treated of in the book.—Gainesville, O., *Courier.*

This is a comprehensive and admirable book in its field. —Cincinnati (O.) *Commercial-Gazette.*

It contains invaluable information for water-works men.—Charlestown (W. Va.) *Standard.*

The universal interest which is taken in the question of water supply gives a value to anything that can throw any light on the subject. Newark has voted to appropriate $6,000,000 for a new supply. Jersey City is about to adopt some new system, and other cities of the State are discussing the water supply question with more or less earnestness.

At such a time a compendium of information and statistics like the "American Water Works Manual," just issued from the office of ENGINEERING NEWS, New York, commands unusual interest. In this work the smallest details are given and the information is admirably arranged for convenient reference. We have seldom seen a more complete statistical work or one having a greater practical value.—Newark (N. J.) *Journal.*

A good reference work for civil engineers and persons interested in water-works contracting.—Milwaukee *Evening Wisconsin.*

What will prove as valuable in one branch of investments as Poor's Manual has proven in railroad investments, is The Manual of American Water-Works, published by ENGINEERING NEWS. Water-works bonds have become an important feature in the list of investment securities. A vast amount of information relative to the water-works of the United States is contained in the book, which will be published annually, and will be found useful to every banker and general investor, as well as to engineers and contractors.—*Daily Indicator*, (N. Y.)

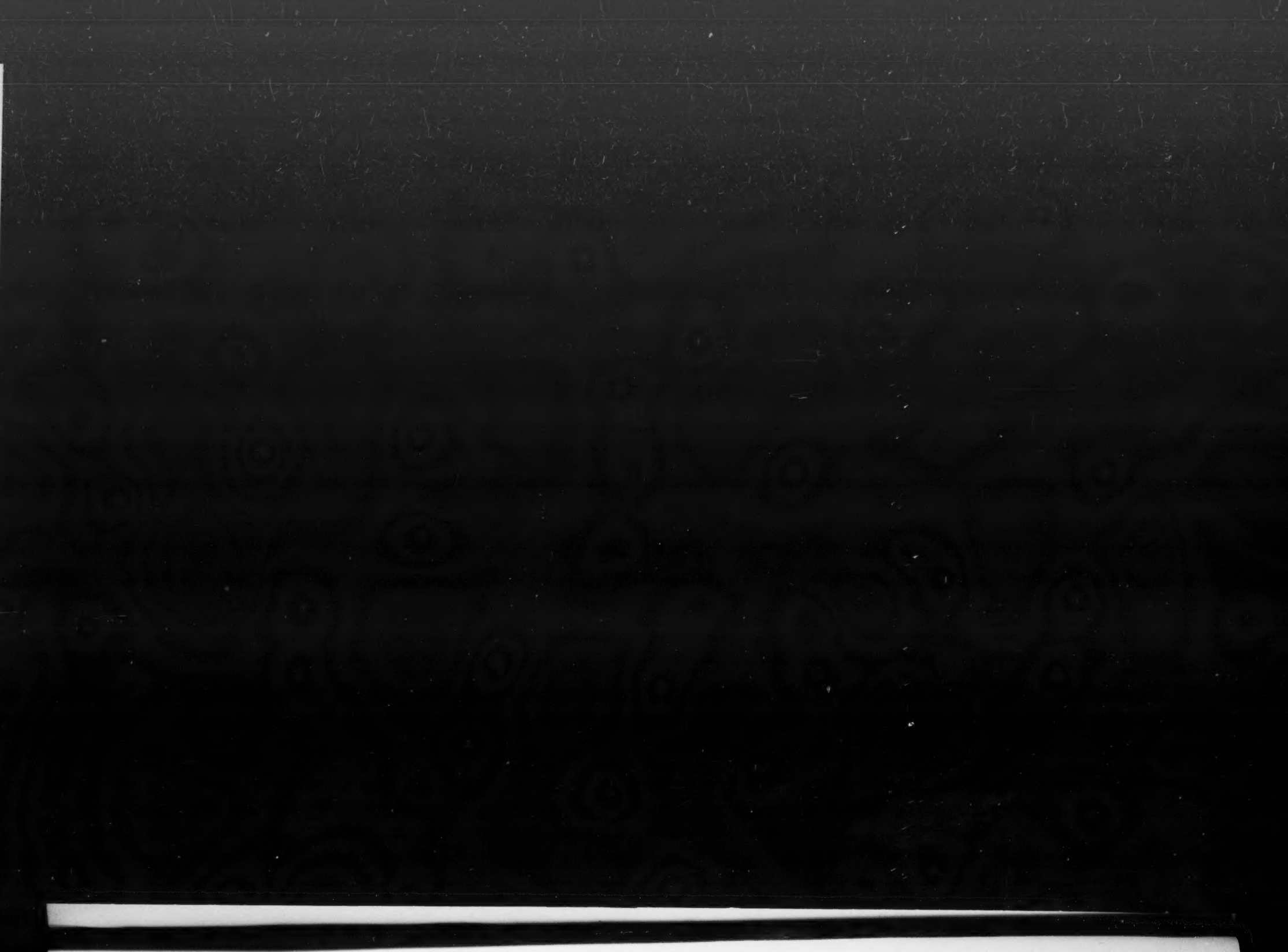
The American Water-Works Manual is an exceedingly valuable book for the investor, and we commend it to such of our readers as are interested.—*Stockholder* (N. Y.)

The book is invaluable to all who desire full and trustworthy information on the subject of water-works.—Indianapolis *Journal.*

It gives evidence of a great deal of careful labor, and should be valuable for reference.—Cincinnati *Enquirer.*

Extensions and Additions to Water-Works Systems Contemplated for 1889. *(See The Manual of American Water-Works for Addresses.)*

(*Continued from page 466.*)

City or Town.	Pipe.	Hydrants.	Valves.	Meters.
Massachusetts.				
Marblehead	*31,680 ft.	Numb	er not	given.
Swampscott	Laying pipe to Nahant			
Rhode Island.				
Drownville	2,000 ft. 3-in.			6
Virginia.				
Staunton	3,600 ft. 3 and 1 in.	5	5	
Georgia.				
Athens	5,000 ft. 8 and 6 in.	15	5	15
Tennessee.				
Columbus	4,000 ft.			
Ohio.				
Salem	†			
Troy	‡ 1,000 ft			
Michigan.				
Lake City	1,300 ft	6		
Mt. Pleasant	2,600 ft. 4-in.			
Illinois.				
Oak Park	15,840 ft			
Wisconsin.				
Janesville	5,600 ft	15		
Minnesota.				
Pipestone	2,000 ft. 4-in.	4	2	
Kansas.				
Arkansas City	To extend mains.	23		
Baxter Sp'ngs	26,400 ft. 8 to 4-in.	40	15	16
Larned	5,400 ft. 6 and 4-in.	3		
Parsons	2,000 ft. 4-in	3		
Salina	26,400 ft. 8 to 4-in.	45	18	15
Dakota.				
Salem	4,000 ft. 4-in.	1		
Watertown	7,500 ft. 8 to 4-in.	20	12	
Nebraska.				
David City	5,280 ft.	Materi	als pur	chased.
Texas.				
Laredo	36,400 ft. 8 to 4-in.	66	20	
New Mexico.				
Silver City	¶ 6,000 ft. 4-in	6	6	10
Oregon.				
Arlington	§ 2,640 ft. 4 to 1¼-in	8	2	
Ashland	** 79,200 ft			
Astoria	10,560 ft. 6-in.		"Can't	say."
Corvallis	††			
Eugene City	7,500 ft. 4 to 2-in.	6	6	
Salem	10,500 ft. 6 and 4-in	10	6	4
California.				
Anderson	5,280 ft. 6-in.	9	4	
Colusa	¶¶ 800 ft. 3-in.			
Eureka	§§ 28,000 ft. 3-in.	8	8	10
Nipomo	***			
Fortersville	6,000 ft. 3 and 2-in.			
Redwood City	—— 6 and 4-in.	15		
Riverside	58,080 ft. 6 to 2-in.	36	22	
San Diego	42,240 ft. 15 to 6-in.	105	45	500
Sonora	5,000 ft. 6 and 4-in.			
Thermalito Colony	11,000 ft. 4 to 1-in.		40	
Arizona.				
Phœnix	††† 42,240 ft. 10 to 3-in.	50	1	15
Prescott	530 ft. 6 and 4-in.			

* To erect a stand-pipe 30 ft. in diameter by 100 ft high.
† Contemplate placing roof over storage reservoir.
‡ New pump to be put in.
¶ To extend water tunnel 200 ft.
§ A 30-ft. windmill will be erected.
** "We are planning. Please tell some good pipe company to send us catalogue."
†† To improve tower. May lay some 6-in. pipe.
‡‡ Contemplate construction of new reservoir.
¶¶ A tank 92 ft. high to be erected for fire protection. Capacity, 25,000 galls.
§§ Knowles pump to be added.
*** General improvements are being made, including the construction of a new reservoir. Additions will be governed according to demands.
††† Will add a tower 14 ft. in diameter by 100 ft. high. Also place two 1,000,000 gall. Dean pumping engines.